

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

This chapter analyzes the environmental consequences of impacts expected to occur as a result of implementing any future actions (including, but not limited to, any decisions to lease and/or develop geothermal resources) that may be taken consistent with the four alternatives: Alternative 1, the Proposed Action; Alternative 2, the Proposed Action with enhanced stipulations for greater sage-grouse, TCPs, and sacred sites; Alternative 3, the No Action Alternative; or Alternative 4 (Preferred Alternative), the Proposed Action with updated sage-grouse management. The scope of the analysis is at a programmatic level, as discussed in Section 1.8, Scope of Analysis, and is commensurate with the details of the alternatives and the availability of data. Current conditions of the planning area, as described in Chapter 3, Affected Environment, provide the baseline for assessing impacts.

4.1.1 Methods of Impact Analysis

Consent to the issuance of a geothermal lease has no direct impact on the environment; however, it is a commitment of the resource for potential future exploration, drilling operations and development, utilization, and reclamation and abandonment, which are subject to environmental review and permits. Therefore, an analysis is provided of the potential impacts of the various stages that may follow a leasing decision along with the potential cumulative impacts throughout the entire planning area.

The methodology for the following impact assessment conforms to the guidance found in the following sections of the CEQ regulations for implementing NEPA: 40 CFR 1502.24 (Methodology and Scientific Accuracy); 40 CFR 1508.7 (Cumulative Impact); and 40 CFR 1508.8 (Effects). CEQ regulations require that agencies “rigorously explore and objectively evaluate” the impact of all alternatives. The alternatives presented in this EIS propose National Forest System consent or no consent to geothermal leasing of lands. These alternatives

have no direct impacts on the planning area, as explained below. Therefore the focus of this analysis is on the impacts associated with the stages that may follow leasing, which are project level exploration, development, and utilization.

The alternatives described in Chapter 2 do not specifically propose development of a geothermal resource. For this reason, the analysis relies on the reasonably foreseeable development scenario (RFDS), which projects future geothermal leasing and development on National Forest System lands within the Humboldt-Toiyabe Geothermal Leasing Planning Area over the next 20 years based on best professional judgment. The RFDS assumes all lands are available for leasing and, therefore, does not consider any allocations (lands open or closed to geothermal leasing) prescribed under the alternatives. Its purpose is to demonstrate the level of expected development and show where the potential development might occur. It is important to note that the magnitude and extent of impacts on any resource or resource use would vary depending on the amount of land apportioned for each lease. A lease can range in size from 640 acres up to 5,120 acres.

Consent to lease lands, in and of itself, does not cause any direct impacts as defined by the CEQ regulations, which state that such effects “are caused by the action and occur at the same time and place” (40 CFR 1508.8(a)). Prior to any ground disturbance or other future actions that would occur consistent with implementing the plan, further decision making would be required. This decision making must take place prior to future actions and involves consideration of a wide variety of factors, including, but not limited to, policy initiatives about timing of actions, whether any applications are submitted, whether funding is available, and compliance with other authorities and policies.

The regulations governing geothermal leasing and development provide for several decision stages prior to any ground-disturbing activities taking place and may include further compliance with applicable authorities during these decision stages. Under this regulatory scheme, until BLM receives and adjudicates an application for a permit to drill or other authorization that includes specific information about the location, scope, scale, and timing of a particular project, impacts of actual development that might follow lease issuance are speculative. At each decision stage, the BLM retains the authority to approve, deny, or approve, subject to conditions, any permit based on compliance with applicable authorities and policies. Therefore, the analysis of effects of development in this EIS reflects a more general, programmatic approach.

Any future development of geothermal resources, if and when it does take place, would result in effects. It is reasonable, therefore, to foresee that on-the-ground impacts would occur if the Forest Service consents to leasing and the BLM issues geothermal leases. Those impacts would not occur, however, until some point in the future following several decision stages. The following analysis focuses primarily on both direct and indirect impacts of future development of

geothermal resources based on the foreseeable on-the-ground actions, taking into consideration the stipulations and procedures outlined in the 2008 Geothermal PEIS and Appendix A. These impacts cannot be analyzed site-specifically, but they can be analyzed in general terms for the leasing area based on the RFDS outlined in Chapter 2. The following assumptions from the RFDS were applied for the analysis in Chapter 4.

- Three to six power plants (30-MW to 50-MW capacity) would be built in the Bridgeport Decision Area, and one 50-MW capacity power plant would be constructed in each of the Austin, Ely, and Tonopah Decision Areas.
- Each power plant would disturb up to a maximum of 367 acres.
- The development of six power plants with a maximum disturbance of 367 acres each would result in 2,202 maximum acres of disturbance in the Bridgeport Geothermal Decision Area.

Consideration of the effects of future actions that might occur under the alternatives described in this chapter also takes into account the phenomena of greenhouse gas emissions, carbon sequestration, and climate change. The nature and characteristics of the impacts related to greenhouse gas emissions associated with geothermal development as a result of the alternatives would be the same as those described in Section 4.1.1 of the 2008 Geothermal PEIS as incorporated by reference (BLM and Forest Service 2008). It is expected that Alternative 3 would result in the least amount of geothermal development, the least amount of new, clean energy being brought online, and the least potential for reducing greenhouse gas emissions. It is expected that projects developed consistent with Alternative 1 would result in the greatest amount of geothermal development, the greatest amount of new, clean energy being brought online, and the greatest potential for reducing greenhouse gas emissions.

4.1.2 Organization of Chapter 4

Because it is not possible to identify specific impacts from the decision to provide consent to geothermal leasing, the evaluation of environmental resources has focused on those resources most likely to be affected during future geothermal development activities. Therefore, this chapter provides a programmatic presentation of common impacts from indirect and direct geothermal development by analyzing the RFDS and assessing potential impacts during the four sequential phases of geothermal development: (1) exploration, (2) drilling operations, (3) utilization, and (4) reclamation and abandonment. The discussion of impacts from geothermal development activities is general in nature and would occur regardless of the alternative.

Following the discussion of impacts associated with the RFDS and common impacts associated with each phase of geothermal resource development, a programmatic analysis illustrates the nature and magnitude of the impact on the

resource that would be associated with any anticipated future action taken consistent with each of the respective alternatives.

4.2 LAND USE

This section discusses impacts on land use from the alternatives described in Chapter 2.

4.2.1 Scoping Comments on the Resource

No specific comments related to land use and access were received from the public. However, land use issues include development of geothermal energy on National Forest System lands in a manner compatible with other multiple use resource values and with Forest Service management objectives.

4.2.2 How Resource Impacts Were Evaluated

Methodology

Land status baseline information in Section 3.2 was reviewed for an understanding of current lands and realty program goals, management practices, and ownership breakdown in the planning area. This known information was overlain with the actions found under each alternative in Chapter 2, and conclusions were drawn based on an understanding of how these types of actions may affect the use of National Forest System lands and adjacent landowners.

This section also describes potential impacts on access roads. Maintained roads provide appropriate ingress, egress, and access in the planning area. The following discussion of the impacts on access focuses on actions that restrict or facilitate access opportunities on federal, state, and county maintained highways and roadways, and Forest Service-maintained system roads described in Section 3.2.

Indicators

The consent or non-consent of National Forest System lands for geothermal leasing and the issuance of geothermal leases would not impact land use and access. Existing ROWs and communication sites would be managed to protect valid existing rights. However, impacts could result from future construction and operation of geothermal energy projects in the planning area based on future leases. Potential impacts on land use and access could occur if reasonably foreseeable future actions were to:

- Conflict with management goals and objectives set forth by the Forest Service in order to sustain the health, productivity, and diversity of federal lands;
- Result in proposed uses that are incompatible with existing or adjacent land uses; or

- Cause a change in access opportunities or changes vehicle movement on designated roadways within and adjacent to the planning area.

4.2.3 Common Impacts Associated with Geothermal Development

Due to the inability to predict the location, scope, scale, and timing of future development, the following impact analysis provides a general description of common impacts on land use and access from geothermal development. The information presented in the Common Impacts to Land Use with Geothermal Development section of the 2008 Geothermal PEIS (BLM and Forest Service 2008) is incorporated by reference and summarized here.

Impacts on land uses, adjacent land owners, and access include the possibility for increased traffic as a result of new or enhanced roads developed during the exploration, utilization, and drilling operations phases of geothermal development. Additional roads could improve motorized and non-motorized access to previously inaccessible areas, therefore increasing motorized traffic in those areas and possibly affecting activities such as grazing and recreation. The magnitude and extent of the impact would depend on the current land use in the specific area proposed for development which is unknown at this time. The impact would last for the duration that the roads were in use (short term for exploration phase, longer term during drilling operations and utilization phases) but would be expected to be reclaimed in the reclamation and abandonment phase.

Lands converted to geothermal use during the drilling and utilization phases (well pad, power plant, pipeline, and transmission line construction and uses) would result in long term impacts on other uses such as grazing, recreation, hunting, and mining, as geothermal use would displace these activities and uses. Short term (lasting only the duration of the actual activity) impacts would include maneuvering construction and maintenance equipment and vehicles associated with the drilling and utilization phase activities.

Reclamation and abandonment phase activities would likely return the landscape to its pre-construction condition, and the previous uses and activities could resume.

4.2.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative 1

Under this alternative, the Forest Service would implement a comprehensive list of stipulations and other procedures to serve as consistent guidance for future geothermal leasing. Relevant stipulations (Appendix A) designed to protect existing land uses include a CSU stipulation to ensure compatibility with urban interface areas to minimize the potential for adverse impacts on residential areas, schools, or other adjacent urban land uses. In addition, in accordance with the identified stipulations and procedures, BLM and operators would

contact appropriate agencies, property owners, and other stakeholders early in the project planning process to identify potentially sensitive land uses and issues. It is expected that these measures would effectively avoid or minimize impacts over the long term on land uses and access by identifying conflicts early in the process and requiring specific measures to maintain public uses and values. Based on the RFDS provided in Chapter 2, there would be approximately three to six power plants developed in this area resulting in a maximum of approximately 2,202 acres of disturbance. It is anticipated that impacts under Alternative 1 would be the minimized due to the implementation of lease stipulations.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse, and Native American concerns would increase the acreage subject to NSO stipulations. The NSO stipulations for sage-grouse would apply to approximately 169,600 acres within the decision area. This alternative would result in greater limitations for the siting of geothermal plants and infrastructure, which could result in more concentrated areas of development.

Alternative 3

Issuing geothermal leases on a case-by-case basis based on the Humboldt and Toiyabe LRMPs is not expected to directly affect land use and access. However, if the Forest Service does not provide consent to geothermal leasing, lease nominations and project development would likely result in fragmented and segregated land uses and adverse access conditions on roads within the decision area. Measures to protect land use on National Forest System lands and adjacent lands from impacts would be determined on a case by case basis. Due to the uncertainty of total acreage considered for geothermal leasing and development, it is not possible to quantify the total acreage affected in this decision area. Development of the individual leasing approvals and stipulations would also continue to vary depending on the site and would delay application processing time.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area. This alternative would result in greater limitations for the siting of geothermal plants and infrastructure, which could result in more concentrated areas of development.

4.2.5 Potential Impacts for the Austin Geothermal Decision Area

Alternative 1

Impacts on land use and access would be similar to those described for the Bridgeport Geothermal Decision Area. Based on the RFDS provided in Chapter 2, there would be approximately one power plant developed in this area resulting in a maximum of approximately 367 acres of disturbance. It is anticipated that impacts under Alternative 1 would be the minimized due to the implementation of lease stipulations.

Alternative 2

Impacts on land use and access would be similar to those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 1,600 acres within the decision area.

Alternative 3

Impacts on land use and access would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Under this alternative, the NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area. NSO would apply to the majority of the decision area and limit the potential for development. However, other previously authorized land uses would not be affected.

4.2.6 Potential Impacts for the Ely Geothermal Decision Area

Alternative 1

Impacts on land use and access would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts on land use and access would be the similar to those described for the Bridgeport Geothermal Decision Area. However, the NSO stipulations for sage-grouse would apply to approximately 3,300 acres within the decision area and would extensively limit the potential for development. Other previously authorized land uses would not be affected.

Alternative 3

Impacts on land use and access would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

The updated habitat data and protection measures for greater sage-grouse would decrease the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area. This

would result in increased potential for development within the decision area but would not preclude other previously authorized uses of the area.

4.2.7 Potential Impacts for the Tonopah Geothermal Decision Area

Alternative 1

Impacts on land use and access would be similar to those described for the Bridgeport Geothermal Decision Area. Based on the RFDS provided in Chapter 2, there would be approximately one power plant developed in the Tonopah Geothermal Decision Area resulting in a maximum of approximately 367 acres of disturbance. It is anticipated that impacts under Alternative 1 would be minimized due to the implementation of lease stipulations. However, due to the small size of the decision area, there would be less flexibility in siting a geothermal plant and infrastructure. This could result in adverse impacts on land use and access within the decision area and to adjacent lands and roads.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for Native American concerns would increase the acreage subject to NSO stipulations.

Alternative 3

Impacts on land use and access would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

The updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to the entire decision area. This would restrict geothermal development within the decision area but would not affect other previously authorized land uses.

4.3 SPECIAL DESIGNATIONS

This section discusses impacts on special designations from the alternatives described in Chapter 2.

4.3.1 Scoping Comments on the Resource

Commenters requested that special designation areas, including congressionally designated areas (e.g., Wilderness, National Historic Sites) and administratively designated areas (e.g., Inventoried Roadless Areas, Research Natural Areas, and other designations made in forest plans) be eliminated from leasing.

Issue: How will other land uses and special designation areas be addressed, and what areas will be automatically closed to geothermal leasing? Specific concerns included, but were not limited to: State Wildlife Areas, State trust lands, Inventoried Roadless Areas, and National Historic and National Scenic Trails.

4.3.2 How Resource Impacts Were Evaluated

Methodology

The methods to determine potential effects on special designation areas included a review of geographic information systems (GIS) data for the planning areas. The GIS data were overlain with the actions found under each alternative in Chapter 2, and conclusions were drawn based on an understanding that these types of actions may affect special designation areas.

Indicators

Potential impacts on special designations could occur if reasonably foreseeable future actions were to:

- Conflict with management goals and objectives set forth by the Forest Service in order to categorize, protect, and manage special designation areas;
- Conflict with conservation goals for the area; or
- Result in proposed land uses that are incompatible with existing or adjacent special designation areas.

Assumptions

This analysis assumes the following:

- Congressionally designated areas would be closed to leasing.
- If the prescription for an administrative designation, as described in the applicable land use plan(s), allows for geothermal leasing, then these areas could remain open to geothermal leasing at the discretion of the Forest Supervisor.
- An Inventoried Roadless Area designation would not prohibit geothermal leasing; however, a nondiscretionary restriction would be placed on any leases within the designation and no new road construction or reconstruction would be allowed without approval by the Secretary of Agriculture. As a result, these areas generally may not contain geothermal development.
- No surface occupancy would be allowed on segments of rivers determined to be potentially eligible for Wild and Scenic Rivers (WSR) status by virtue of a Wild and Scenic Rivers inventory, including a corridor of 0.25 miles from the high water mark on either side of the bank.

4.3.3 Common Impacts Associated with Geothermal Development

Due to the inability to predict the location, scope, scale, and timing of future development, the following impact analysis provides a general description of common impacts on special designation areas from geothermal development.

The information presented in the Common Impacts to Special Designations with Geothermal Development section of the 2008 Geothermal PEIS (BLM and Forest Service 2008) is incorporated by reference and summarized here.

Congressionally designated areas are typically withdrawn from geothermal development, so no impacts on congressional designations are anticipated from geothermal exploration. Administrative designations are not automatically withdrawn from geothermal development; however, activities likely to affect the resources and values identified for protection under these designations would be precluded.

If development was proposed in an administrative designation area, prior to any activity occurring resources and values identified for protection under the designation would be analyzed for potential impacts. Activities affecting resources and values identified for protection in these areas would be prohibited. The effects of geothermal exploration on special designations are expected to be negligible.

4.3.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative 1

Under this alternative, the Forest Service would implement a comprehensive list of stipulations and procedures to serve as consistent guidance for future geothermal leasing. Relevant stipulations (Chapter 2 and Appendix A) designed to protect special designation areas include applying a non-discretionary restriction on any leases within National Forest System inventoried roadless areas. Specifically, no new road construction or reconstruction would be allowed in designated roadless areas unless approved by the Secretary of Agriculture. If future legislation or regulation changes the roadless area designation, the restriction would be revised along with any appropriate environmental review. In addition there would be no surface occupancy of potentially eligible Wild and Scenic Rivers.

Based on the RFDS provided in Chapter 2, there would be approximately three to six power plants developed in this area resulting in a range of approximately 1,101 to 2,202 acres of disturbance. It is anticipated that impacts under Alternative 1 would be negligible because restrictions and closures for special designation areas would largely preclude development.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be protected with an NSO stipulation. The NSO stipulations for sage-grouse would apply to approximately 169,600 acres within the decision area.

Alternative 3

Under Alternative 3, lease applications would continue to be processed on a case-by-case basis. The number of acres that could impact special designation areas is unknown; however, impacts are expected to be negligible because management actions for special designations either close or restrict development.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area. The number of acres that would be impacted by special designation areas is unknown; however, management actions for special designations would reduce the possibility for impacts by either closing or restricting development in the decision area.

4.3.5 Potential Impacts for the Austin Geothermal Decision Area**Alternative 1**

There are no special designation areas in the Austin Geothermal Decision Area; therefore, there would be no impacts.

Alternative 2

There are no special designation areas in the Austin Geothermal Decision Area; therefore, there would be no impacts.

Alternative 3

There are no special designation areas in the Austin Geothermal Decision Area and therefore, there would be no impacts.

Alternative 4 (Preferred Alternative)

There are no special designation areas in the Austin Geothermal Decision Area; therefore, there would be no impacts.

4.3.6 Potential Impacts for the Ely Geothermal Decision Area**Alternative 1**

Impacts on special designation areas would be similar to those described for the Bridgeport Geothermal Decision Area. Based on the RFDS provided in Chapter 2, there would be approximately one power plant developed in this area resulting in a range of approximately 53 to 367 acres of disturbance. The non-discretionary restriction on designated roadless areas would likely preclude geothermal development in the portions of the Cottonwood and Indian Creek Roadless Areas within the Ely Geothermal Decisions Area, meaning impacts would be negligible.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be protected with an NSO stipulation.

Alternative 3

Impacts on special designation areas would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impact under this alternative would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse would decrease the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area.

4.3.7 Potential Impacts for the Tonopah Geothermal Decision Area**Alternative 1**

Approximately 160 acres of the Arc Dome-Carvers Roadless Area lies within the Tonopah Geothermal Decision Area; therefore, development of a geothermal plant is unlikely and would not be allowed unless new road construction is approved by the Secretary of Agriculture.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for Native American concerns would further limit the acreage that would be available for development.

Alternative 3

Impacts on special designation areas would be similar to those described under Alternative 1; however, development of individual leasing approvals and stipulations would vary and would delay application processing time.

Alternative 4 (Preferred Alternative)

The updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO and further restrict geothermal development within the entire decision area, reducing the possibilities for impacts on special designation areas.

4.4 RECREATION

This section discusses impacts on recreation from the alternatives described in Chapter 2.

4.4.1 Scoping Comments on the Resource

Commenters noted that the proposed project appears to have no adverse effects on areas already in use for recreation, e.g., designated mountain bike trails and future four-wheel drive trails.

Issue: Impacts on recreation including the restriction, disturbance, or direct loss of recreational opportunities, values, and safety. Recreational opportunities that may be limited, disturbed, or lost include but are not limited to hiking, mountain biking, hunting, fishing, wildlife viewing, camping, bird watching, and off-highway vehicle use. This also includes the potential for a loss of spirituality, remoteness, solitude, wilderness, and naturalness in the area.

4.4.2 How Resource Impacts Were Evaluated

Methodology

The methods to determine potential effects on recreation included a review of GIS data for the decision areas. The GIS data were overlain with the actions found under each alternative in Chapter 2, and conclusions were drawn based on an understanding that these types of actions may affect known recreation resources and settings (e.g., trails, roads, campgrounds, and the recreation opportunity spectrum setting).

Indicators

Potential impacts on recreation could occur if reasonably foreseeable future actions were to:

- Result in a loss of recreational access;
- Conflict with existing recreational uses of the area; or
- Diminish existing recreational experiences and opportunities by altering the recreational setting.

Assumptions

This analysis assumes the following:

- Current recreation activities could continue until site-specific geothermal operations begin.
- Geothermal activities would improve motorized recreational access but decrease opportunities for a remote recreational experience.
- Recreational activities will persist in similar manner and extent as current usage patterns but will likely increase over time.

4.4.3 Common Impacts Associated with Geothermal Development

Due to the inability to predict the location, scope, scale, and timing of future development, the following impact analysis provides a general description of common impacts on recreation from geothermal development. The information

presented in the Common Impacts to Recreation with Geothermal Development section of the 2008 Geothermal PEIS (BLM and Forest Service 2008) is incorporated by reference and summarized here.

The development of geothermal resources would alter the physical, social, and operational character of the recreation setting, thereby altering an individual's experiences.

All phases of development, including surveying, drilling, utilization, operation, and maintenance, would result in the physical restriction of recreation areas, temporarily reducing the amount of land available for recreational use and accessible trails. This would displace some recreation users and limit recreation activities. Recreation users could experience an increase in noise, vibration, and dust. Additionally, exploration could shift the recreation opportunity spectrum setting, by varying degrees, towards an urban setting. New access roads could increase public access to previously inaccessible areas, thereby increasing recreational opportunities for some users. However, this would also alter the experience for people seeking a more remote experience in those same areas.

Increased traffic from reclamation and abandonment activities could affect timely public access as described above. All disturbed lands would be reclaimed in accordance with Forest Service standards and recreation activities could resume, improving recreational opportunities.

4.4.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative 1

Under this alternative, the Forest Service would implement a comprehensive list of stipulations and procedures to serve as consistent guidance for future geothermal leasing. Relevant stipulations (Chapter 2) designed to protect recreation include applying NSO stipulations to developed recreation facilities, designated National Scenic and Recreation Rivers; and applying controlled surface use stipulations to recreational areas as specified in Appendix A.

Based on the RFDS provided in Chapter 2, there would be approximately three to six power plants developed in this area resulting in a range of approximately 367 to 2,202 acres of disturbance. It is anticipated that impacts under Alternative 1 would be the minimized due to the implementation of lease stipulations. Alternative 1 would allow for more flexibility in siting geothermal plants and infrastructure.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be protected with an NSO stipulation. The NSO stipulations for sage-grouse would apply to

approximately 169,600 acres within the decision area. Alternative 2 would limit the siting of geothermal plants and infrastructure more than Alternative 1.

Alternative 3

Under Alternative 3, lease applications would continue to be processed on a case-by-case basis. The number of acres that could impact recreation is unknown; however, impacts would be site-specific and similar to the impacts under the four phases of geothermal development identified in Section 4.4.3. Under this alternative, development would be fragmented and segregated which could increase impacts on recreation when compared with Alternative 1. Development of the individual leasing approvals and stipulations would also continue to vary depending on the site and would delay application processing time.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 189,300 acres within the decision area. This alternative would result in greater limitations for the siting of geothermal plants and infrastructure, which could result in more concentrated areas of development, resulting in fewer impacts on recreation within the NSO boundary but a potentially higher concentration of visual and noise impacts for recreationists in areas outside of the NSO boundary.

4.4.5 Potential Impacts for the Austin Geothermal Decision Area

Alternative 1

Impacts on recreation would be similar to those described for the Bridgeport Geothermal Decision Area. Based on the RFDS provided in Chapter 2, there would be approximately one power plant developed in this area resulting in a range of approximately 53 to 367 acres of disturbance. It is anticipated that impacts under Alternative 1 would be the minimized due to the implementation of lease stipulations.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be protected with an NSO stipulation. The NSO stipulations for sage-grouse would apply to approximately 1,600 acres within the decision area. This alternative would limit siting of geothermal plants and infrastructure more than Alternative 1.

Alternative 3

Impacts on recreation would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts on recreation would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area. This alternative would result in greater limitations for the siting of geothermal plants and infrastructure.

4.4.6 Potential Impacts for the Ely Geothermal Decision Area***Alternative 1***

Impacts on recreation would be the same as those described for the Austin Geothermal Decision Area.

Alternative 2

Impacts on recreation would be the same as those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 3,300 acres within the decision area.

Alternative 3

Impacts on recreation would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impact under this alternative would be similar to those described for the Austin Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area.

4.4.7 Potential Impacts for the Tonopah Geothermal Decision Area***Alternative 1***

Impacts on recreation would be the same as those described for the Austin Geothermal Decision Area.

Alternative 2

Impacts on recreation would be the same as those described for the Austin Geothermal Decision Area.

Alternative 3

Impacts on recreation would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

The updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO and further restrict geothermal development within the entire decision area. Therefore, impacts on recreation would be minimal.

4.5 GEOLOGIC RESOURCES AND SEISMIC SETTING

This section discusses impacts on geologic resources and seismic setting from the alternatives described in Chapter 2.

4.5.1 Scoping Comments on the Resource

No comments or issues on geology and seismicity were received from the public during the scoping period.

4.5.2 How Resource Impacts Were Evaluated

Methodology

The potential effects of geothermal development were evaluated by assessing the effects that anticipated future actions consistent with the alternatives would have on the geology and unique geologic resources of the planning area. In this section, impacts on geologic features are evaluated only from the perspective of scientific value (rather than cultural, recreational, or scenic value).

Indicators

The following indicators have been identified in order to evaluate potential impacts on geology and seismicity:

- Earthquake activities, ground failure, or landslides;
- Substantial erosion of geological units, such as with landslides and subsidence; and
- Unstable geological units, including parent material, slope angle, amount of vegetation, and location of fault lines within a project area disturbance footprint. Facilities located on a geologic unit that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse.

4.5.3 Common Impacts Associated with Geothermal Development

The information presented in the Common Impacts on Geology Resources and Seismic Setting Associated with Geothermal Development section of the 2008 Geothermal PEIS (BLM and Forest Service 2008) is incorporated by reference and summarized here.

Although the concerns identified above within the Indicators Criteria are discussed here and in the PEIS, due to the inability to predict future types of development, their timing, and locations, the potential for them to occur can only be fully evaluated for once a site-specific proposal is submitted. Any subsequent, site-specific projects that might occur in the planning area would undergo NEPA review, during which geotechnical investigations may be conducted if deemed necessary.

The potential impacts on geologic resources from geothermal development mainly concern physical disturbance such as movement, removal or destruction of geologic resources. These impacts would result from ground disturbing activities including construction of roads, well pads and other power plant facilities. Drilling operations and reclamation could also result in impacts. In addition, roads that are not reclaimed would provide greater public access resulting in increased wear and vandalism of sensitive geologic features

Seismic risk could increase if geothermal resource development includes high-pressure reinjection along any faults intersected by the injection well. However, the risk is reduced where geothermal fluid withdrawn from the resources is used and then reinjected back into the system for a near zero net change.

Subsidence can occur where groundwater is pumped from underground aquifers at a rate exceeding the rate that it is replenished. The majority of geothermal development techniques include reinjection of the geothermal fluid after the heat is utilized and maintaining static pressure of the geothermal reservoir. Therefore, the potential for subsidence is low.

Enhanced Geothermal Systems

The 2008 Geothermal PEIS does not address Enhanced Geothermal Systems technology or its potential to cause earthquakes, also called “induced seismicity,” so this topic will be discussed in the following paragraphs.

The process of stimulating production and injection wells through the injection of water under pressure, and often at a much cooler temperature than the receiving rock, results in the expansion of existing fractures and sometimes the creation of new fractures through the movements of masses of rock at depth. These movements of masses of rock at depth result in seismic activity. Since the seismic activity is created by the reservoir stimulation, it is distinguished from natural seismicity with the term *induced* seismicity. Whether or not the induced seismicity is able to be felt at the surface depends upon the depth of the reservoir, the degree to which the rock masses are shifted from the stimulation, and the nature of the overlying geology and its ability to transfer the shock waves to the surface.

Typically, natural fractures vary in length on a scale of 1 to 10 meters. Seismic energy radiated during the shearing process depends on the length of the fracture or the stress release from the constraining natural forces. A majority of the observed data from existing Enhanced Geothermal Systems projects suggest that the higher energy radiated from the shearing is caused by a high stress release from relatively small joint lengths (Michelet et al. 2004). This would suggest that if there were some perceived events on the surface, the frequency content would be too high to generate any seismic risk, but minor events may still raise concern among local inhabitants.

As part of the NEPA process for any specific Enhanced Geothermal Systems proposal, mitigation measures would be developed to address the potential for seismic-related risks.

Protocols

The International Energy Agency developed a peer-reviewed and accepted protocol for dealing with induced seismicity during geothermal projects and the DOE has adopted them. Such protocols may be made a requirement of any Enhanced Geothermal Systems project.

Induced Seismicity Hazards Risk Analysis

An independent consultant can be contracted to prepare an induced seismicity and seismic risk hazards analysis. Such analyses identify and quantify the risk associated with induced seismicity and can focus its content on potential effects on nearest communities and homeowners.

Prediction of Event Number and Magnitude

Recent advances have been made in predicting the number and magnitude of induced seismicity events that can be expected during hydroshearing operations. Mechanisms of induced seismicity can be quantified and a seismogenic index can be developed for a specific area. Such an index would characterize the potential number of induced seismicity events greater than a particular magnitude as a function of the injected volume. Changes to injection rates and total fluid volumes can be used during operations to manage seismic effects. The maximum allowable magnitude event is determined by the induced seismicity and seismic hazard risk analysis. Evaluation of the seismogenic index would allow project geologists to place initial bounds on the hydroshearing operational and mitigation limits for a given project.

Control of Rate and Pressure and Flow-back after Injection

Mitigation measures can be implemented if induced seismicity events approach defined limits. The primary mitigation method may be reducing the rate of water injection to a level where induced seismicity rate and magnitude are within an acceptable range. A secondary method can be to backflow the well to reduce reservoir pressure.

The utilization phase of Enhanced Geothermal Systems projects could produce microseismic events. Seismic data collection arrays may be set up prior to any well stimulation so that induced seismicity can be monitored in real time. This monitoring allows supervising geologists to track where the reservoir is opening up and allows operations to be modified, as needed. The ongoing monitoring of microseismicity with multi-station sensor arrays would allow regulators to continuously review the project and halt or make modifications to operations if the risk to properties is considered to be too great.

4.5.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative 1

The Forest Service would consent to lease up to approximately 602,115 acres of National Forest System lands in the Bridgeport Geothermal Decision Area. Impacts of the nature and type described in Section 4.5.3 would likely result should development occur. As there are no known unique geologic features within the decision area, there would be no impacts on them as a result of geothermal development. If, at a later date, unique geologic features are determined to be within the area of effect of proposed development, then stipulations for avoiding direct impacts, such as erosion or destruction of the feature(s) and indirect impacts (visual, atmospheric and/or aural intrusions to the landscape) in the features' landscape would need to be applied to prevent impacts. As the area is still seismically active, there is a small increased likelihood for seismic activity to affect geothermal development facilities; alternately, should pressurized reinjection or Enhanced Geothermal Systems be considered as options to geothermal development, there is an increased likelihood for induced seismicity. Both of these options would require further analysis if proposed as part of a geothermal development project.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be subject to NSO stipulations. The NSO stipulations for sage-grouse would apply to approximately 169,600 acres within the decision area. This alternative would result in greater limitations for the siting of geothermal plants and infrastructure, which could result in more concentrated areas of development.

Alternative 3

Under Alternative 3, lease applications would continue to be processed on a case-by-case basis. The number of acres likely to be affected under this alternative is unknown. Issuing geothermal leases on a case-by-case basis includes avoiding potential impacts from anticipated future actions on any unique geologic resources. In addition, unique geologic resources may receive protection through avoidance and mitigation measures for other resources, where those resources include unique geologic features. Examples include features that are part of a Class I visual landscape, features of cultural importance to Native Americans, or caves with bat populations.

Under this alternative, the list of stipulations, or procedures from the 2008 Geothermal PEIS would serve as guidance for future geothermal leasing and development; however, there would not be any regionally specific stipulations unique to the planning area. Overall potential impacts on geologic resources from anticipated future actions would be similar to those identified in Section 4.5.3 on a case-by-case basis.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area. This alternative would result in greater limitations for the siting of geothermal plants and infrastructure, which could result in more concentrated areas of development.

4.5.5 Potential Impacts for the Austin Geothermal Decision Area***Alternative 1***

The Forest Service would consent to lease up to approximately 3,961 acres of National Forest System lands in the Austin Geothermal Decision Area. Impacts as a result of geothermal development would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts under Alternative 2 would be similar to those described for the Bridgeport Geothermal Development Area. The NSO stipulations for sage-grouse would apply to approximately 1,600 acres within the decision area.

Alternative 3

Impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts on geological resources and seismic setting would be similar to those described for the Bridgeport Geothermal Decision Area. However, the NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area. This alternative would result in greater limitations for the siting of geothermal plants and infrastructure.

4.5.6 Potential Impacts for the Ely Geothermal Decision Area***Alternative 1***

The Forest Service would consent to lease up to approximately 3,538 acres of National Forest System lands in the Ely Geothermal Decision Area. Impacts as a result of geothermal development would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts would be similar to those described for the Bridgeport Geothermal Decision Area. However, the NSO stipulations for sage-grouse would apply to approximately 3,300 acres within the decision area. Therefore, this alternative would result in greater limitations for the siting of geothermal plants and infrastructure.

Alternative 3

Impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts would be similar to those described for the Bridgeport Geothermal Decision Area. However, the updated habitat data and protection measures for sage-grouse would decrease the acreage subject to NSO when compared with Alternative 2. The NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area.

4.5.7 Potential Impacts for the Tonopah Geothermal Decision Area**Alternative 1**

The Forest Service would consent to lease up to approximately 166 acres of National Forest System lands in the Tonopah Geothermal Decision Area. Impacts as a result of geothermal development would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 3

Impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

The updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO and further restrict geothermal development within the entire decision area. Therefore, impacts on geologic resources and seismic setting would be minimal.

4.6 ENERGY AND MINERAL RESOURCES

This section discusses impacts on energy and mineral resources from the alternatives described in Chapter 2.

4.6.1 Scoping Comments on the Resource

No comments or issues related to energy and minerals were received from the public during the scoping period.

4.6.2 How Resource Impacts Were Evaluated**Methodology**

Impact analysis for Energy and Minerals was conducted by examining whether the leasing of areas for geothermal resources would have the potential to

impact mining, oil and gas leasing, and electricity generation or transmission, or the subsequent development of those resources.

Indicators

The potential effects of geothermal development were evaluated by assessing the effects that anticipated future actions consistent with implementation of the alternatives described in Chapter 2 would have on energy and mineral resources. Geothermal leasing would have no direct impacts on energy and mineral resources. Impacts would occur from subsequent development activities.

Potential impacts on energy and mineral resources could occur if reasonably foreseeable future actions were to:

- Result in the construction of transmission lines that would affect the feasibility of other energy development along the transmission corridor; or
- Develop roads that would encourage other energy and mineral exploration in otherwise undeveloped areas.

4.6.3 Common Impacts Associated with Geothermal Development

Developing energy and mineral resources on federal lands is subject to location and operational constraints resulting from national, regional, and local laws, regulations, policies, and guidelines associated with protecting other environmental resources (e.g., endangered species). These protections include withdrawing or closing lands to energy and mineral resource activities, exclusion areas, buffer zones around sensitive areas, limitations on surface occupancy, seasonal limitations, and other permit stipulations. Changes in these regulations and policies have the direct effect of increasing or decreasing the land available for energy and resource development and associated costs.

The impacts on energy and mineral resources from potential geothermal exploration and development activities would be greatly dependent on the local presence and characteristics of energy and mineral resources. Due to the inability to predict future development scenarios, including types of development, timing, and location, the following impact analysis provides a general description of common impacts on energy and mineral resources from geothermal resource development.

Improving existing roads and constructing new roads for geothermal resource exploration, utilization of the geothermal resources, and reclamation and abandonment of geothermal resources would have a negligible to minor impact on the exploration for other energy and mineral resources in the immediate area. The degree of impact would depend on the existing limits to access in the area and the distance of the roads to the other mineral resources. However, as discussed in Section 4.2, existing rights-of-way would be managed to protect

valid existing rights. Drilling operations would preclude developing any other energy or mineral resources on the same land. Introducing new transmission lines would encourage developing other energy resources along the transmission line. Mineral resource developments would be encouraged due to the new availability of power for their operations. These impacts would be reduced with increased distance from the power plant, roads, and transmission lines. Upon reclamation and abandonment of geothermal operations, any other ongoing operations in the area would have to take over maintenance of shared facilities (e.g., roads, transmission lines).

4.6.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative 1

The Forest Service would consent to leasing up to approximately 602,115 acres of National Forest System lands. There would be no impacts on energy and minerals as a result of leasing however there could be impacts associated with future geothermal development. Impacts from geothermal development would be similar to those described previously as common to all. In addition, Alternative 1 could increase the value and amount of geothermal energy production for the state and electrical power brought onto the Nevada and national grids.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage subject to NSO stipulations. The NSO stipulations for sage-grouse would apply to approximately 169,600 acres within the decision area.

Alternative 3

Under Alternative 3, lease applications would continue to be processed on a case-by-case basis. The number of acres likely to be affected under this alternative is unknown. Areas nominated for leasing would be assessed based on the Humboldt and Toiyabe LRMPs. Geothermal resources are managed as fluid leasable minerals, which includes oil and gas. Therefore, policies on closure of land to fluid minerals leasing or restrictions on the fluid minerals activities apply to both geothermal and oil and gas resources. Roadless areas do not include automatic closure to fluid minerals leasing and, therefore, do not include closure to geothermal leasing. Other lands have exclusion or buffer zones (e.g., National Historic Trails) that are generally one-quarter mile either side of the centerline. These types of constraints are applied or expanded at the discretion of the individual Forest Service Authorized officers based on the specific project's impact analysis. Under Alternative 3, lease nominations and project development would likely result in fragmented or segregated development of energy and mineral resources. Development of the individual leasing approvals

and stipulations would also continue to vary depending on the site and would delay application processing time.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 2. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area. This alternative would result in greater limitations for the siting of geothermal plants and infrastructure.

4.6.5 Potential Impacts for the Austin Geothermal Decision Area

Alternative 1

The Forest Service would consent to lease up to approximately 3,961 acres of National Forest System lands. The types of impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 2

The types of impacts would be similar to those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 1,600 acres within the decision area.

Alternative 3

Impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts on energy and mineral resources would be similar to those described for the Bridgeport Geothermal Decision Area. However, the NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area.

4.6.6 Potential Impacts for the Ely Geothermal Decision Area

Alternative 1

The Forest Service would consent to lease up to approximately 3,538 acres of National Forest System lands. The types of impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 2

The types of impacts would be similar to those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 3,300 acres within the decision area.

Alternative 3

Impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area.

4.6.7 Potential Impacts for the Tonopah Geothermal Decision Area**Alternative 1**

The Forest Service would consent to lease up to approximately 166 acres of National Forest System lands. The types of impacts would be the same as those described for the Bridgeport Geothermal Decision Area. However, impacts from geothermal development within the Tonopah Geothermal Decision Area would disturb the entire 166 acre decision area and thus reduce the likelihood of other mineral or energy developments in the area.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for Native American concerns would increase the acreage subject to NSO stipulations and limit the siting of geothermal plants or infrastructure.

Alternative 3

Impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts would be similar to those described for the Bridgeport Geothermal Decision Area. The updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO, which would include the entire decision area and further restrict geothermal development within the entire decision area.

4.7 PALEONTOLOGICAL RESOURCES

This section discusses impacts on paleontological resources from the alternatives described in Chapter 2.

4.7.1 Scoping Comments on the Resource

No scoping comments or issues were received from the public regarding paleontological resources.

4.7.2 How Resource Impacts Were Evaluated

Methodology

Potential impacts on paleontological resources were evaluated using the Potential Fossil Yield Classification system as noted in the 2008 Geothermal PEIS (BLM and Forest Service 2008). This evaluation of potential effects on paleontological resources assumes that geothermal leasing alternatives associated with the largest acreage of disturbance correlate with the greatest likelihood of impacts on paleontologically sensitive (Potential Fossil Yield Classifications 3 through 5) geologic formations.

Based upon a reasonable prediction of possible future types of development, but not the timing and/or location, the following impact analysis provides a general description of common impacts on paleontological resources from geothermal resource development.

Indicators

Paleontological resource impacts primarily concern the potential destruction of nonrenewable fossil resources and the loss of information associated with these resources, and includes destruction as the result of surface disturbance and the unlawful or unauthorized collection of fossil remains. Potential impacts on paleontological resources could occur if reasonably foreseeable future actions were to:

- Result in the loss of any fossil that could yield information important to prehistory, or that embodies the distinctive characteristics of a type of organism, environment, period of time, or geographic region;
- Conflict with paleontological resource management objectives and guidelines established by the Forest Service; or
- Disturb paleontologically sensitive geologic formations (Potential Fossil Yield Classifications 3 through 5).

4.7.3 Common Impacts Associated with Geothermal Development

This analysis assumes that potential for impacts on both surface and subsurface paleontological resources is directly proportional to the amount of surface disturbance associated with a proposed action. At the programmatic level of analysis, it is not possible to identify and evaluate areas of higher paleontological sensitivity with respect to locations of proposed surface disturbance. Therefore, potential impacts on paleontological resources under each alternative can only be generally estimated, and they correlate directly to the amount of anticipated surface disturbance proposed under each alternative.

Surface disturbance activities related to geothermal exploration or development, such as grading, drilling wells, seismic and resistivity surveys, pipeline construction, and plant construction have the potential to impact fossils

that may occur on or underneath the surface in areas containing paleontologically sensitive geologic units. Without mitigation, such as monitoring during construction, excavation of materials, or avoidance of surface exposures, these fossils and the paleontological data they could provide could be destroyed, rendering them permanently unavailable. Impacts can typically be mitigated to below a level of significance by implementing paleontological mitigation such as those mentioned above and identified in the stipulations. If data recovery is the prescribed mitigation, this can also result in fossils being salvaged that may never have been unearthed as the result of natural processes; these newly exposed fossils would become available for scientific research, education, display, and preservation into perpetuity at a public museum.

Throughout the utilization, operations, maintenance, and reclamation stages, there would be an increase in workers and an increase in the accessibility of public lands, both of which allow for an increased potential for loss of paleontological resources by vandalism and unlawful collecting (poaching). These impacts are difficult to mitigate to below the level of significance, but they can be greatly reduced by increasing public awareness about the scientific importance of paleontological resources through education, community partnerships, and interpretive displays, and by informing the public about penalties for unlawful destruction or unlawful collection of these resources from public lands.

4.7.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative 1

Under Alternative 1, the Forest Service would consent to lease up to approximately 602,115 acres of National Forest System lands and up to 2,202 acres would be disturbed. Should exploration or development occur, impacts similar to those described under common impacts would likely result. Since there is a known paleontological resource within the Bridgeport Geothermal Decision Area, there is potential for impacts as a result of geothermal development. In addition, considering that the majority of the area (approximately 80 percent) is of Cenozoic era geology, there is a higher likelihood for paleontological resources from this era to be discovered during project development, although this would be lessened due to the small surface-disturbance footprint for each project. If, at a later date, paleontological resources are determined to be within the area of effect of proposed development, then project-specific conditions of approval for avoiding said resources would need to be applied to prevent impacts.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be protected with an

NSO stipulation. The NSO stipulations for sage-grouse would apply to approximately 169,600 acres within the decision area.

Alternative 3

Under Alternative 3, lease applications would continue to be processed on a case-by-case basis. The number of acres likely to be affected under this alternative is unknown.

Under this alternative, the stipulations, or procedures from the 2008 Geothermal PEIS would serve as guidance for future geothermal leasing and development; however, there would not be any specific stipulations for the planning area. Overall, potential impacts on paleontological resources from anticipated future actions would be similar to those identified above, though the fragmented approach could result in greater impacts on paleontological resources. Development of the individual leasing approvals and stipulations would also continue to vary depending on the site and would delay application processing time.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO and reduce the likelihood of impacts on paleontological resources. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area.

4.7.5 Potential Impacts for the Austin Geothermal Decision Area

Alternative 1

The Forest Service would consent to lease up to approximately 3,961 acres of National Forest System lands in the Austin Geothermal Decision Area and up to 367 acres would be disturbed. Impacts would be similar to those described as common for all decision areas; however, considering that the majority of the area (approximately 87 percent) is of Cenozoic era geology, there is a higher likelihood for paleontological resources from this era to be discovered during project development. Potential impacts would be limited due to the small surface-disturbance footprint for each project. Nevertheless, if paleontological resources are determined to be within the area of effect of proposed development, then the existing stipulations for avoiding said resources would need to be applied to prevent impacts.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be protected with an NSO stipulation. The NSO stipulations for sage-grouse would apply to approximately 1,600 acres within the decision area.

Alternative 3

Impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts on paleontological resources would be similar to those described for Alternative 2. However, the NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area.

4.7.6 Potential Impacts for the Ely Geothermal Decision Area**Alternative 1**

The Forest Service would consent to lease up to approximately 3,538 acres of National Forest System lands in the Ely Geothermal Decision Area and up to 367 acres would be disturbed. Impacts would be similar to those described as common for all decision areas; however, considering that all of the area is of Cenozoic era geology, there is a higher likelihood for paleontological resources from this era to be discovered during project development.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be protected with an NSO stipulation. The NSO stipulations for sage-grouse would apply to approximately 3,300 acres within the decision area.

Alternative 3

Impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 2. However, the NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area.

4.7.7 Potential Impacts for the Tonopah Geothermal Decision Area**Alternative 1**

The Forest Service would consent to lease up to approximately 166 acres of National Forest System lands in the Tonopah Geothermal Decision Area and up to 166 acres would be disturbed. Considering that the entire decision area is of Cenozoic era geology, impacts would be similar to those described for the impacts common to all decision areas; however, considering that all of the area is of Cenozoic era geology, there is a higher likelihood for paleontological resources from this era to be discovered during project development.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for Native American concerns would increase the acreage that would be protected with an NSO stipulation.

Alternative 3

Impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

The updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO and restrict geothermal development within the entire decision area. Therefore, impacts on paleontological resources would be minimal.

4.8 SOIL RESOURCES

This section discusses impacts on soil resources from the alternatives described in Chapter 2.

4.8.1 Scoping Comments on the Resource

Commenters suggested that the Forest Service should develop leasing stipulations to lessen any impacts on soil resources, including soil loss, sedimentation, and soil erosion.

4.8.2 How Resource Impacts Were Evaluated**Methodology**

The methods to determine potential effects on soil resources included review of available soil data for the four geothermal decision areas. Soil classification and soil order data was reviewed to determine susceptibility to wind and water erosion. Potential impacts on prime farmlands were also reviewed as part of the analysis.

Indicators

The consent or non-consent of National Forest System lands for geothermal leasing and the issuance of geothermal leases would not impact soils or prime farmlands. However, impacts would result from future construction and operation of geothermal energy projects in the planning area based on future leases. Potential impacts on soils would occur if reasonably foreseeable future actions were to:

- Remove prime farmlands from production;
- Take place on slopes of greater than 40 percent;
- Increase the mid- to long-term erosion of soil resources in the area;
or
- Cause soil resource compaction.

The potential impacts of the alternatives were evaluated on the basis of amount of area that would be open for exploration and development and the general presence of easily eroded soils and prime farmlands.

4.8.3 Common Impacts Associated with Geothermal Development

Common impacts on soil resources from geothermal development include physical disturbance (e.g., movement or removal), compaction, changes to erosion patterns, and changes in current use as farmland. Any development or infrastructure (e.g., wells, roads, or pipelines) on steep slopes would increase erosion and could increase risk of landslides.

Due to the inability to predict the location, scope, scale, and timing of future development, the following impact analysis provides a general description of common impacts on soil resources from geothermal resource development. The degree of impact would vary depending on local conditions and site specific soil conditions.

A detailed description of geothermal development operations relative to soil resources are described in detail in the 2008 Geothermal PEIS, the phases of geothermal development including exploration, drilling operations, utilization, and reclamation and abandonment are also discussed in detail in the 2008 Geothermal PEIS.

4.8.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative 1

Under Alternative 1, the Forest Service would consent to lease up to approximately 602,115 acres of National Forest System lands within the Nevada portion of the Bridgeport Ranger District and up to 2,202 acres would be disturbed. Alternative 1 would not have any direct impact on soil resources; however, future geothermal exploration and development activities would disturb soils and potentially result in soil compaction and soil erosion. There are currently no NRCS-designated prime farmlands within the Bridgeport Geothermal Decision Area; therefore, no impacts on farmlands would be expected from future geothermal exploration or development.

Under Alternative 1, leasing would be subject to stipulations from Chapter 2 of the 2008 Geothermal PEIS and other stipulations determined to be reasonable and necessary to protect soil resources, including a stipulation that specifies no surface occupancy or other surface disturbance would be allowed on slopes in excess of 40 percent. This stipulation would reduce potential impacts on soils.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns as NSO stipulations would reduce soil disturbance in those areas but lead to more concentrated development on other areas. The NSO

stipulations for sage-grouse would apply to approximately 169,600 acres within the decision area.

Alternative 3

Issuing geothermal leases on a case-by-case basis based on the Humboldt and Toiyabe LRMPs is not expected to directly affect soils. However, lease nominations and project development would likely result in fragmented and segregated development and adverse impacts on soils within the decision area. Due to the uncertainty of total acreage considered for geothermal leasing and development, it is not possible to quantify the total acreage affected in this decision area. Development of the individual leasing approvals and stipulations would also continue to vary depending on the site and would delay application processing time. Alternative 3 would provide fewer defined protections for soils in regard to geothermal development.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 2. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area.

4.8.5 Potential Impacts for the Austin Geothermal Decision Area

Alternative 1

Under Alternative 1, the Forest Service would consent to lease up to approximately 3,961 acres of National Forest System lands in the Austin Geothermal Decision Area and up to 367 acres would be disturbed. Impacts on these lands would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts associated with Alternative 2 would be the same as those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 1,600 acres within the decision area.

Alternative 3

Impacts associated with Alternative 3 would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts on soil resources would be similar to those described for the Bridgeport Geothermal Decision Area. However, the NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area.

4.8.6 Potential Impacts for the Ely Geothermal Decision Area

Alternative 1

Under Alternative 1, the Forest Service would consent to lease up to approximately 3,538 acres of National Forest System lands in the Ely Geothermal Decision Area and up to 367 acres would be disturbed. Impacts on these lands would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts associated with Alternative 2 would be the same as those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 3,300 acres within the decision area.

Alternative 3

The impacts associated with Alternative 3 are the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 2. However, updated habitat data and protection measures for sage-grouse would decrease the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area.

4.8.7 Potential Impacts for the Tonopah Geothermal Decision Area

Alternative 1

Under Alternative 1, the Forest Service would consent to lease up to approximately 166 acres of National Forest System lands in the Tonopah Geothermal Decision Area and up to 166 acres would be disturbed. Impacts on these lands would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts associated with Alternative 2 would be similar to those described for the Bridgeport Geothermal Decision Area.

Alternative 3

The impacts associated with Alternative 3 would be the same as those described for the Bridgeport Decision Area.

Alternative 4 (Preferred Alternative)

The updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO and restrict geothermal development within the entire decision area. Therefore, impacts on soil resources would be minimal.

4.9 WATER RESOURCES (SURFACE AND GROUND)

This section discusses impacts on water resources from the alternatives described in Chapter 2.

4.9.1 Scoping Comments on the Resource

Commenters requested that the impacts on water resources from geothermal development activities be discussed in the EIS, including impacts on water quantity and quality, aquifers, hot springs and wells, water contamination, and water used for ceremonies, cooking, drinking and recreation.

Issue: Impacts on water resources from activities related to geothermal leasing, which may include the following:

- impacts on water quantity and quality in the region, including aquifers, hot springs, and wells;
- impacts on the critical zone of recharge to the groundwater systems that feed the springs and on which many of the ecosystems of the region depend;
- contamination and depletion of surface water in the region; and
- contamination of water used for ceremonies, irrigation, cooking, drinking, and recreation in the area.

4.9.2 How Resource Impacts Were Evaluated

Methodology

The methods to determine potential effects on water resources and quality included review of water resources GIS data for the planning area. The GIS data were overlain with decision areas, and conclusions were drawn based on an understanding of the types of impacts future actions may have on known water resources (Lakes, Playas, Ponds, Swamps, Wetlands, Streams, Rivers, Aquifers, Hot Springs). Impacts on water resources are evaluated only from the perspective of changes to water availability and quality. Impacts from the perspective of other values (e.g., impacts of water quality on livestock, or reduced flow from a sacred spring) are discussed in sections for the other resources. Because the location of anticipated future development is not known, only general effects on water quality and quantity are discussed.

The following GIS data were used to conduct the analysis:

- National Hydrography Dataset
- National Atlas Aquifer Data
- National Wetland Inventory Data

Indicators

Potential impacts on water resources could occur if anticipated actions consistent with implementing the alternatives described in Chapter 2 were to:

- Involve surface disturbance such as building roads or preparing drill sites or plant sites that could increase erosion or sedimentation;
- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level;
- Use facilities that would substantially degrade surface or groundwater quality; or
- Change conditions such that the geothermal resource itself was degraded.

Assumptions

This analysis assumes the following:

- Leasing land does not involve ground-disturbing activities or any type of construction, so there would be no direct impact on water resources. Impacts would result from activities pursued after leasing.

4.9.3 Common Impacts Associated with Geothermal Development

Due to the inability to predict the location, scope, scale, and timing of future development, the following impact analysis provides a general description of common impacts on water resources from geothermal development. The information presented in the Common Impacts to Land Use with Geothermal Development section of the 2008 Geothermal PEIS (BLM and Forest Service 2008) is incorporated by reference and summarized here.

Common impacts on water resources from geothermal development could include water contamination, lowered groundwater tables and changes in water temperature. The chemical and thermal properties of the geothermal fluid can pose potential threats to surface water and groundwater quality. Geothermal water can contain a variety of dissolved compounds, including silica, sulfates, carbonates, metals and halides. Any mixing of geothermal fluids with surface or groundwater where the chemical and thermal qualities of the geothermal fluids would degrade the other water in the area would potentially damage aquatic ecosystems and contaminate drinking water supplies. The degree of impact would vary greatly depending on local conditions including presence of sole source aquifers, hot springs, and the existing water quality.

4.9.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative 1

Under Alternative 1 the Forest Service would consent to lease up to approximately 602,115 acres of National Forest System lands in the Bridgeport Geothermal Decision Area and up to 2,202 acres would be disturbed. Alternative 1 would not have any direct impact on water resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in impacts discussed in Section 4.9.3. Potential impacts would be reduced through site specific analysis and development of mitigation or protection measures for future projects as well as implementation of BMPs. In addition, implementation of the stipulations outlined in Appendix A would reduce impacts on water resources. Specific stipulations for water resources include the following:

- NSO of water bodies, riparian areas, wetlands, playas, and 100-year floodplains, and a 300-foot buffer for Lahontan cutthroat trout habitat.
- CSU for protection of riparian and wetland habitat would be applied within 500 feet of riparian or wetland vegetation to protect the values and functions of these areas. Measures required will be based on the nature, extent, and value of the area potentially affected.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be protected with an NSO stipulation. The NSO stipulations for sage-grouse would apply to approximately 169,600 acres within the decision area.

Alternative 3

Under Alternative 3, processing of geothermal lease applications and nominations would continue; however, they would be evaluated on a case-by-case basis under separate NEPA analyses. Since the location, timing and types of developments are unknown it is not possible to determine the impacts associated with this alternative. However, leasing on a case-by-case basis could result in fragmented development and development of the individual leasing approvals and stipulations would also continue to vary depending on the site and would delay application processing time.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 2. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area.

4.9.5 Potential Impacts for the Austin Geothermal Decision Area

Alternative 1

Under Alternative 1 the Forest Service would consent to lease up to approximately 3,961 acres of National Forest System lands in the Austin Geothermal Decision Area and up to 367 acres would be disturbed. Impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts would be the same as those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 1,600 acres within the decision area.

Alternative 3

The impacts associated with Alternative 3 would be the same as those described for the Bridgeport Decision Area.

Alternative 4 (Preferred Alternative)

Impacts on water resources would be similar to those described for the Bridgeport Geothermal Decision Area. However, the NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area.

4.9.6 Potential Impacts for the Ely Geothermal Decision Area

Alternative 1

Under Alternative 1 the Forest Service would consent to lease up to approximately 3,538 acres of National Forest System lands in the Ely Geothermal Decision Area and up to 367 acres would be disturbed. Impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts would be the same as those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 3,300 acres within the decision area.

Alternative 3

The impacts associated with Alternative 3 would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts would be similar to those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area.

4.9.7 Potential Impacts for the Tonopah Geothermal Decision Area

Alternative 1

Under Alternative 1 the Forest Service would consent to lease up to approximately 166 acres of National Forest System lands in the Tonopah Geothermal Decision Area and up to 166 acres would be disturbed. Impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts would be similar to those described for the Bridgeport Geothermal Decision Area.

Alternative 3

The impacts associated with Alternative 3 would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

The updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO and restrict geothermal development within the entire decision area. Therefore, impacts on water resources would be minimal.

4.10 AIR QUALITY AND AIR QUALITY RELATED VALUES

This section discusses impacts on air quality from the alternatives described in Chapter 2.

4.10.1 Scoping Comments on the Resource

Commenters requested that air pollution and emissions from geothermal plant activities be addressed for their impacts on land and water resources on National Forest System lands. One issue of concern is the impact on air quality at drill sites and within the surrounding area from dust generated by drilling and transportation on dirt roads, and vehicle and equipment emissions.

4.10.2 How Resource Impacts Were Evaluated

Methodology

The methodology for air quality impact analysis is incorporated by reference from the 2008 Geothermal PEIS (BLM and Forest Service 2008). Additional methodology included comparing potential geothermal development against PSD standards applicable to the Class I airsheds within 100 kilometers of the Bridgeport Ranger District described in Section 3.10 (there are no Class I airsheds within 100 kilometers of the remainder of the planning area). There are no federally designated nonattainment areas in the planning area; therefore, Clean Air Act Conformity guidelines do not apply.

Indicators

Potential impacts on air quality could occur if reasonably foreseeable future actions were to:

- Conflict with or obstruct implementation of the applicable air quality attainment plan;
- Violate any stationary source air quality standard or contribute to an existing or projected air quality violation; or
- Expose sensitive receptors (e.g., concentrations of children, elderly, or persons with respiratory conditions) to major pollutant concentrations.

4.10.3 Common Impacts Associated with Geothermal Development

The information presented in the Common Impacts on Air Quality and Atmospheric Values Associated with Geothermal Development section of the 2008 Geothermal PEIS (BLM and Forest Service 2008) is incorporated here by reference. The common impacts associated with exploration, drilling, utilization, and reclamation and abandonment would be the same as described in the PEIS. Some activities resulting in air quality emissions are common to all phases of a geothermal project lifecycle, while others are specific to certain phases. Table 4-1 in the PEIS summarizes the activities and the criteria pollutants of concern related to those activities.

The nature and extent of geothermal-related development activities that would affect air quality would vary by project, depending on several factors: 1) whether the project is for direct use or indirect use; 2) the size of the project; and 3) for indirect use projects, which type of power plant technology is used. Potential air quality impacts would be evaluated on a project-specific basis, as NEPA would be conducted for each of the potential phases of geothermal development activity: exploration, drilling operations, utilization, and reclamation and abandonment. Site-specific NEPA analysis would include a disclosure of criteria pollutant and hazardous pollutant emissions resulting from the proposed project, as well as the effects of these emissions on potentially affected resources such as soil, water, and biological resources and measures to protect these resources, as needed. The effects of site-specific actions on Class I areas would also be examined. Air permits would also be obtained, as necessary, for each individual phase, and activities at all sites would need to be carried out in conformance with the applicable state implementation plans or SIPs. If required by the Nevada Division of Environmental Protection during the permitting process, air modeling of geothermal plant emissions would be performed to determine potential emissions at plant site boundaries to ensure that emissions comply with state and national air quality standards, including Nevada standards for hydrogen sulfide, and to help determine the need for monitoring equipment or emissions control devices. This section addresses the air quality impacts typically associated with each phase of development, and then examines the role

the development of geothermal energy applications is likely to play in air quality nationwide.

4.10.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative 1

Impacts on air quality would occur from the subsequent phases of geothermal development, including exploration, drilling, utilization, and reclamation and abandonment. Based on the RFDS provided in Chapter 2, there would be approximately three to six power plants developed in the Bridgeport Geothermal Decision Area, with 367 to 2,202 total acres of disturbance. Fugitive dust and equipment and vehicle exhaust emissions associated with well pad and power plant construction and well drilling operations are generally discussed in the 2008 Geothermal PEIS and are incorporated here by reference.

Well drilling poses the greatest potential source of exhaust emissions during geothermal development. Up to 25 production wells and 10 injection wells would be developed per plant, with up to 6 plants developed in the Bridgeport Decision Area. **Table 4-1**, Bridgeport Decision Area Well Drilling Emissions, depicts potential emissions associated with geothermal well development. Emissions would occur over time as described in the RFDS.

Table 4-1
Bridgeport Decision Area Well Drilling Emissions (tons)

	VOC	NO _x	CO	SO ₂	PM ₁₀	PM _{2.5}	CO ₂
Drilling emissions per well ¹	1.09	13.21	4.17	0.31	0.90	0.87	1,615
Drilling emissions per plant ²	38.19	463.72	145.95	10.99	31.38	30.44	56,540
Drilling emissions for RFDS ³	229.14	2,782.31	875.7	65.94	188.29	182.64	339,237

¹Drilling rig engine is assumed to meet a mix EPA Tier 1-3 large-bore diesel emission standards (40 CFR Part 89), 2 Bore/Drill Rigs with 1,000 horsepower engine at 70% load operating 24 hours/day for 45 days, two 500 horsepower generators at 75% load operating 24 hours/day for 45 days, and a 1,000 horsepower auxiliary pump at 80% load operating 8 hours/day for 45 days.

²Conservatively assumes emissions from drilling of 35 production-type wells.

³Assumes 6 plants.

In addition to emission of criteria pollutants, well drilling has the potential to release non-condensable gases, such as carbon dioxide, hydrogen sulfide, methane, and ammonia, as well as trace amounts of mercury and arsenic, when these compounds are contained in the geothermal resource. The amount and ratio of these constituents varies by geothermal resource, with carbon dioxide generally comprising over 95 percent of the non-condensable gases. Hydrogen sulfide is the non-condensable gas of greatest concern because it can pose a threat to human health at high concentrations. Hydrogen sulfide releases are of greatest concern in the event of a well blowout and can be avoided through the use of blowout-prevention equipment. Minor releases of hydrogen sulfide can occur during drilling and flow testing of wells. Monitoring devices can be installed and operated during drilling and testing, and hydrogen sulfide releases

can be abated if necessary to avoid health risks to drill personnel or to mitigate public nuisance odors.

The effects of operating a geothermal power plant would depend upon the size of the power plant, the type of power plant developed, and the makeup of the geothermal resource. Any development within 100 kilometers of the Class I airsheds described in Section 3.10 has the potential to affect air quality within that airshed. While operational emissions from a binary power plant would be specific to the design of the plant, emissions associated with operation of binary power plants are generally limited to emissions of water vapor and gases from the cooling tower and emissions of particulates in cooling tower drift. There is also the potential for releases of hydrocarbons from the working fluid and non-condensable gases found in the geothermal fluids. Emissions of water vapor and gases from cooling towers can form a vapor plume during times of high humidity when the water vapor is not readily absorbed into the atmosphere. Cooling tower drift is a type of moisture release that results when small quantities of water droplets of 10 microns or greater and small amounts of dust and dissolved and suspended solids become airborne and are carried out with the exhaust air. Cooling tower drift can be avoided through the use of drift eliminators or other control technologies. Under normal operations, binary power plants operate in a closed environment, where the geothermal fluid and the working fluid do not contact the atmosphere. Safety systems can be incorporated in the plant design to prevent the accidental release of significant amounts of hydrocarbons to the atmosphere. During maintenance, there may be minor emissions of nitrogen, carbon dioxide, and oxygen from the working fluid system. Operation of a binary power plant would likely have emissions below the level that constitutes a major source of new emissions in the Federal PSD program. Development of other technologies, such as flash plants, could have higher emission rates than those described for binary plants but would also likely fall below the major new source threshold in the Federal PSD program. All development would be subject to other state permitting requirements.

As described in Chapter 2, the Forest Service would implement a comprehensive list of stipulations and procedures to serve as consistent guidance for future geothermal leasing. Requirements for emissions controls would be incorporated into the terms of individual geothermal leases and would require a Construction Emissions Mitigation Plan, including a Fugitive Dust Control Plan, to control construction-related emissions and monitoring. Specific measures within the plan include:

- Stabilize heavily used unpaved construction roads with a non-toxic soil stabilizer or soil weighting agent that will not result in loss of vegetation, or increase other environmental impacts.
- During grading, use water, as necessary, on disturbed areas in construction sites to control visible plumes.

- Vehicle Speed:
 - Limit speeds to 25 miles per hour on stabilized unpaved roads as long as such speeds do not create visible dust emissions.
 - Limit speeds to 10 miles per hour or less on unpaved areas within construction sites on unsterilized (and unpaved) roads.
 - Post visible speed limit signs at construction site entrances.
- Inspect and wash construction equipment vehicle tires, as necessary, so they are free of dirt before entering paved roadways, if applicable.
- Provide gravel ramps of at least 20 feet in length at tire washing/cleaning stations, and ensure construction vehicles exit construction sites through treated entrance roadways, unless an alternative route has been approved by appropriate lead agencies, if applicable.
- Use sandbags or equivalent effective measures to prevent run-off to roadways in construction areas adjacent to paved roadways. Ensure consistency with the project's Storm Water Pollution Prevention Plan, if such a plan is required for the project
- Sweep the first 500 feet of paved roads exiting construction sites, other unpaved roads en route from the construction site, or construction staging areas whenever dirt or runoff from construction activity is visible on paved roads, or at least twice daily (less during periods of precipitation).
- Stabilize disturbed soils (after active construction activities are completed) with a non-toxic soil stabilizer, soil weighting agent, or other approved soil-stabilizing method.
- Cover or treat soil storage piles with appropriate dust suppressant compounds and disturbed areas that remain inactive for longer than 10 days. Provide vehicles (used to transport solid bulk material on public roadways and that have potential to cause visible emissions) with covers. Alternatively, sufficiently wet and load materials onto the trucks in a manner to provide at least one foot of freeboard.
- Use wind erosion control techniques (such as windbreaks, water, chemical dust suppressants, and/or vegetation) where soils are disturbed in construction, access and maintenance routes, and materials stock pile areas. Keep related windbreaks in place until the soil is stabilized or permanently covered with vegetation.
- Administrative controls:
 - Develop a construction traffic and parking management plan that maintains traffic flow and plan construction to minimize vehicle trips.

- Identify any sensitive receptors in the project area, such as children, elderly, and the infirm, and specify the means by which impacts on these populations will be minimized (e.g., locate construction equipment and staging zones away from sensitive receptors and building air intakes).
- Include provisions for monitoring fugitive dust in the fugitive dust control plan and initiate increased mitigation measures to abate any visible dust plumes.

It is expected that these measures would effectively minimize impacts on air quality and atmospheric values by reducing sources of air quality degradation.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage subject to NSO stipulations. The NSO stipulations for sage-grouse would apply to approximately 169,600 acres within the decision area.

Alternative 3

Under Alternative 3, the Forest Service would not issue a comprehensive list of stipulations and procedures to serve as consistent guidance for future geothermal leasing. Indirect air quality impacts would be similar to those described for Alternative 1, though the pace of development could be slower. While a less regimented process would result under Alternative 3, measures to reduce air quality impacts would likely be similar to those that would be required under Alternative 1.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area.

4.10.5 Potential Impacts for the Austin Geothermal Decision Area

Alternative 1

Impacts on air quality would be the same or similar in nature to those described for the Bridgeport Geothermal Decision Area. Based on the RFDS provided in Chapter 2, there would be approximately one power plant developed in this area, resulting 53 to 367 acres of disturbance. Localized emissions from development would be similar to the Bridgeport decision area, though much less development would occur. Impacts under Alternative 1 would be the minimized through the measures described above.

Up to 25 production wells and 10 injection wells would be developed per plant, with 1 plant developed in the Bridgeport Decision Area. **Table 4-2**, Austin, Ely, and Tonopah Decision Areas Well Drilling Emissions, depicts potential emissions associated with geothermal well development in the Austin Decision Area. Emissions would occur over time as described in the RFDS.

Table 4-2
Austin, Ely, and Tonopah Decision Areas Well Drilling Emissions (tons)

	VOC	NO _x	CO	SO ₂	PM ₁₀	PM _{2.5}	CO ₂
Drilling emissions per well ¹	1.09	13.21	4.17	0.31	0.90	0.87	1,615
Drilling emissions per plant/RFDS ²	38.19	463.72	145.95	10.99	31.38	30.44	56,540

¹Drilling rig engine is assumed to meet a mix US Environmental Protection Agency Tier 1-3 large-bore diesel emission standards (40 CFR Part 89), 2 Bore/Drill Rigs with 1,000 horsepower engine at 70% load operating 24 hours/day for 45 days, two 500 horsepower generators at 75% load operating 24 hours/day for 45 days, and a 1,000 horsepower auxiliary pump at 80% load operating 8 hours/day for 45 days.

²Conservatively assumes emissions from drilling of 35 production-type wells. RFDS assumes one plant would be developed in each decision area; emissions shown are for one plant.

Alternative 2

Impacts on air quality would be the same or similar to those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 1,600 acres within the decision area.

Alternative 3

Impacts on air quality would be the same or similar to those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts on air quality and air quality related values would be similar to those described for the Bridgeport Geothermal Decision Area. However, the NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area.

4.10.6 Potential Impacts for the Ely Geothermal Decision Area

Alternative 1

Impacts on air quality would be the same or similar to those described for the Austin Geothermal Decision Area.

Alternative 2

Impacts on air quality would be the same or similar to those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 3,300 acres within the decision area.

Alternative 3

Impacts on air quality would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for the Bridgeport Geothermal Area. However, updated habitat data and protection measures for greater sage-grouse would decrease the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area.

4.10.7 Potential Impacts for the Tonopah Geothermal Decision Area**Alternative 1**

Impacts on air quality would be the same or similar to those described for the Austin Geothermal Decision Area.

Alternative 2

Impacts on air quality would be the same or similar to those described for the Bridgeport Geothermal Decision Area.

Alternative 3

Impacts on air quality would be the same or similar to those described for the Austin Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts on air quality would be the same or similar to those described for the Bridgeport Geothermal Decision Area. However, the updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO and restrict geothermal development within the entire decision area. Therefore, impacts on air resources would be reduced.

4.11 VEGETATION

This section discusses impacts on vegetation from the alternatives described in Chapter 2.

4.11.1 Scoping Comments on the Resource

Commenters stressed that the EIS analysis address the potential impacts on plant species and habitats throughout the region affected by the proposed project.

Issue: Effects on vegetation, including the following:

- loss of vegetation cover;
- loss of native plants;
- loss of medicinal and culturally significant plants; and/or

- increased potential for establishment and/or expansion of non-native species.

4.11.2 How Resource Impacts Were Evaluated

Methodology

Leasing geothermal resources would not affect vegetation or important habitats and communities. These resources would be affected only by development of specific geothermal development projects that occurred subsequent to the leasing action. Potential impacts of geothermal development were evaluated based on the typical disturbance of geothermal projects for the various stages of development and then assessed based on projected intensity as described in the RFDS. The types of vegetation and important habitats and communities that could be affected by geothermal development depend on the specific location of the proposed projects which are unknown at this time. In general, the vegetation communities described in Section 3.11 could be affected, as described below, by geothermal development.

Indicators

Potential impacts on vegetation could occur if anticipated future actions consistent with implementing the alternatives described in Chapter 2 were to:

- Affect a plant species, habitat, or natural community recognized for ecological, scientific, recreational, or commercial importance;
- Affect a species, habitat, or natural community that is specifically recognized as biologically significant in local, state, or federal policies, statutes, or regulations;
- Establish or increase noxious weed populations;
- Destroy or extensively alter habitats or vegetation communities in such a way that would render them unfavorable to native species; or
- Conflict with Forest Service management strategies.

Assumptions

This analysis assumes the following:

- NSO stipulations would prevent direct disturbance to vegetation by restricting surface-disturbing activities where they are applied.
- CSU stipulations could be used to avoid impacts on sensitive vegetation in certain areas.
- The degree of impact attributed to any one disturbance or series of disturbances would be influenced by several factors, including location in the watershed; the type, time, and degree of disturbance;

existing vegetation; the amount, type, and timing of precipitation; and mitigating actions applied to the disturbance.

- The Forest Service would comply with applicable Forest Service weed control plans.

4.11.3 Common Impacts Associated with Geothermal Development

The information presented in the Common Impacts on Vegetation Associated with Geothermal Development section of the 2008 Geothermal PEIS (BLM and Forest Service 2008) is incorporated by reference and summarized here. Additional information on the specific vegetation communities present in the planning area is also discussed.

Due to the inability to predict the location, scope, scale, and timing of future development, the following impact analysis provides a general description of common impacts on vegetation from geothermal resource development. As such, this section will qualitatively address the impacts on vegetation and important habitats and communities.

Regardless of the location of geothermal development projects, the nature of the impacts from exploration and development to vegetation would be similar in all vegetation communities. Vegetation would be affected by direct destruction and removal, fugitive dust, exposure to contaminants such as oil and fuel leaks from heavy equipment, erosion, accidental fire caused by on-site workers or heavy equipment, and the introduction of invasive species. The extent of the impacts is typically associated with the size of the area that is disturbed and the types of vegetation habitats and communities present. The ability of an area to recover from disturbance also affects the extent of the damage. In general, localized effects from geothermal development on the scale anticipated by the RFDS to vegetation communities that are common within the decision area, such as pinyon-juniper woodland, would be unlikely to change the composition or health of most vegetation communities.

4.11.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative 1

Based on the RFDS, a total of three to six power plants would be constructed. As a result, up to 2,202 acres would be permanently disturbed within the Bridgeport Geothermal Decision Area, causing impacts as described in Section 4.11.3. The greatest impacts from geothermal leasing are likely in the pinyon-juniper and sagebrush vegetation communities, since these communities have the greatest acreage in the decision area. NSOs for sage-grouse would be applied on up to approximately 75,000 acres, which would protect vegetation from removal in these areas. Water bodies, riparian areas, and wetlands would be protected with an NSO stipulation, and a CSU stipulation would be applied within 500 feet of these areas. This would help to reduce impacts on these areas from vegetation removal and disturbance.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be protected with an NSO stipulation. The NSO stipulations for sage-grouse would apply to approximately 169,600 acres within the decision area. However, the locations of sage-grouse nesting and early brood rearing habitat would need to be field verified during future phases of leasing and development.

Alternative 3

Under Alternative 3, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on local land use plans. The number of acres that could impact vegetation is unknown; however, impacts would be site-specific and similar to the impacts under the four phases of geothermal development identified in the PEIS. Under this alternative fragmented and segregated planning for vegetation could result, which often substantially increases impacts. Development of the individual leasing approvals and stipulations would also continue to vary depending on the site and would delay application processing time.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 2. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area.

4.11.5 Potential Impacts for the Austin Geothermal Decision Area**Alternative 1**

Based on the RFDS, a total of one plant would be constructed. As a result, up to 367 acres would be permanently disturbed within the Austin Geothermal Decision Area, causing impacts as described in the 2008 Geothermal PEIS and Section 4.11.3. The greatest impacts from geothermal leasing are likely in the sagebrush vegetation community, since this community has the greatest acreage in the decision area. NSOs would protect vegetation from removal in these areas. There are no water bodies, riparian areas, or wetlands within the decision area, so there would be no impacts on these vegetation communities.

Alternative 2

Impacts under Alternative 2 would be the same as those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 1,600 acres within the decision area.

Alternative 3

Under Alternative 3, impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts on vegetation would be similar to those described for the Bridgeport Geothermal Decision Area. However, the NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area.

4.11.6 Potential Impacts for the Ely Geothermal Decision Area**Alternative 1**

Based on the RFDS, a total of one plant would be constructed. As a result, up to 367 acres would be permanently disturbed within the Ely Geothermal Decision Area, causing impacts as described in the 2008 Geothermal PEIS and Section 4.11.3. The greatest impacts from geothermal leasing are likely in the sagebrush vegetation community, since this community has the greatest acreage in the decision area. NSOs for sage-grouse would be applied on 3,300 acres, which would protect vegetation from removal in these areas. There are no water bodies, riparian areas, or wetlands within the decision area, so there would be no impacts on these vegetation communities.

Alternative 2

Impacts under Alternative 2 would be similar to those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 3,300 acres within the decision area.

Alternative 3

Under Alternative 3, impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse would decrease the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area.

4.11.7 Potential Impacts for the Tonopah Geothermal Decision Area**Alternative 1**

Based on the RFDS, a total of one plant would be constructed. As a result, up to 367 acres would be permanently disturbed within the Tonopah Geothermal Decision Area, causing impacts as described in the 2008 Geothermal PEIS and Section 4.11.3. The greatest impacts from geothermal leasing are likely in the salt desert shrub and semi desert shrub vegetation communities, since these communities have the greatest acreage in the decision area. There are no water

bodies, riparian areas, or wetlands within the decision area, so there would be no impacts on these vegetation communities.

Alternative 2

Impacts under Alternative 2 would be similar to those described for the Bridgeport Geothermal Decision Area.

Alternative 3

Under Alternative 3, impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO and restrict geothermal development within the entire decision area. Therefore, impacts on vegetation resources would be minimal.

4.12 FISH AND WILDLIFE

This section discusses impacts on fish and wildlife from the alternatives described in Chapter 2.

4.12.1 Scoping Comments on the Resource

The following is a summary of scoping comments and issues submitted during the scoping process:

General Wildlife

- Commenters identified project shortfalls relating to wildlife and proposed measures to minimize and mitigate impacts.
- Commenters directed the Forest Service to consider the impacts, including mortality, behavior, and habitat fragmentation, on wildlife and wildlife habitat from the need to construct new transmission lines.

Birds

- Commenters were concerned with potential impacts on cliff nesting raptors in the Toiyabe Range and the Ely District area.
- Commenters requested that the impact analysis for wildlife include migratory bird species that temporarily use habitat in the planning area.

Terrestrial Wildlife

- Commenters recommended avoiding areas where sensitive wildlife resources (e.g., near water sources, mule deer crucial winter habitat, key migration and movement corridors, etc.) exist. Specifically, areas where leasing should be avoided include the east side of the Pine Grove Hills, Gray Hills, and Wellington Hills to

Round Mountain as these areas are crucial winter range for mule deer. Key mule deer movement corridors are equally important to ensure the continued existence of mule deer on the Bridgeport Ranger District and should be removed from leasing.

Aquatic Wildlife

- Commenters were concerned with potential impacts on cold-water native game and non-game fishes, threatened and endangered species, as well as warm water fishes – specifically, sport and protected endemic fishery concerns in the White River, Ellison Creek, and Smith Creek.

Issue: Impacts on critical big game winter range, sage-grouse leks, and other wildlife habitats as a result of geothermal leasing decisions. Impacts may include:

- disruption of mating, foraging, and other behaviors;
- conflicts with existing conservation plans and recovery goals;
- reduced forage and available water for wildlife; and
- loss or fragmentation of wildlife habitat.

Issue: Impacts on migratory birds and raptors, including eagles, as a result of geothermal leasing decisions. Impacts may include:

- disruption of mating, foraging, and other behaviors;
- conflicts with existing conservation plans and recovery goals;
- reduced forage and available water for wildlife; and
- loss or fragmentation of wildlife habitat.

Issue: Impacts on aquatic species and their habitats as a result of geothermal leasing decisions.

4.12.2 How Resource Impacts Were Evaluated

Methodology

Leasing of geothermal resources does not affect fish and wildlife. These resources would be affected only by development of specific geothermal projects. Potential impacts of geothermal development were evaluated based on the typical disturbance of geothermal projects for the various stages of development and then assessed based on projected intensity as described in the RFDS. The types of fish and wildlife that could be affected by geothermal development depend on the specific location of the proposed project, the time of year, the project design, and its environmental setting.

The analysis used Forest Service MIS and species of interest as a proxy for general impacts on non-sensitive fish and wildlife. Impacts on federally listed or Forest Service sensitive species are discussed in Section 4.12. Since most fish and wildlife species rely to some extent on the vegetation within the planning area, impacts on vegetation, as described in Section 4.11, would also likely impact fish and wildlife.

Indicators

Potential impacts on fish and wildlife could occur if anticipated future actions consistent with implementing the alternatives described in Chapter 2 were to:

- Adversely affect a population by substantially reducing its numbers, causing a fish or wildlife population to drop below self-sustaining levels, or causing a substantial loss or disturbance to habitat. Such effects could include vehicle impacts and crushing, increased predation, habitat fragmentation, or loss of seasonally important habitat;
- Have a substantial adverse impact on nesting migratory birds, including raptors, as protected under the Migratory Bird Treaty Act;
- Interfere with the movement of any resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites; or
- Conflict with the wildlife management strategies of the Forest Service.

Assumptions

This analysis assumes the following:

- NSO stipulations would prevent direct disturbance to habitats and species by restricting surface-disturbing activities where they are applied.
- TL stipulations would help to prevent direct disturbance to species during sensitive periods, such as during winter, when forage is sparse, and during breeding and birthing.
- Disturbance of a key or critical component of a species habitat would be detrimental, with the degree dependent on the importance of the habitat component to the maintenance of the population.
- Habitat conditions and quality are directly linked to the health, vigor, and cover of vegetation communities, as well as soil conditions and water quality and quantity.

- Habitat disturbance caused by damage to vegetation, noise, human presence, and increased dust would often displace wildlife beyond the actual disturbance footprint, although some wildlife may adapt over time depending on the nature of the disturbance and the species being impacted.

4.12.3 Common Impacts Associated with Geothermal Development

The information presented in the Common Impacts on Fish and Wildlife Associated with Geothermal Development section of the 2008 Geothermal PEIS (BLM and Forest Service 2008) is incorporated by reference and summarized here. However, additional information specific to this EIS includes consideration of the particular fish and wildlife species present within the planning area.

Individuals, communities, or populations could be affected from geothermal activities from the following stressors and associated impacts on vegetation and important habitats:

- Habitat removal leading to a net loss of important habitats and communities and fragmentation of wildlife habitat for species requiring large contiguous tracts. This could disrupt migration, increase the risk of invasive species and alter water and seed dispersion and wildlife use.
- Habitat disturbance caused by damage to vegetation, noise, human presence, and increased dust, leading to disruption of breeding and migration, injury or mortality, reduced vegetation health, and wildlife avoidance.
- Introduction or spread of invasive vegetation affecting wildlife by reducing habitat quality and species diversity, thereby affecting foraging and breeding behavior.
- Wildlife injury or mortality as a result of project activities, use of heavy equipment, chemical control of weeds or vegetation, or use of project components by predators.
- Impacts from erosion, including the loss of habitat for terrestrial species and increased turbidity, which can directly affect fish and other aquatic biota.
- Increased risk of fire.
- Increases in noise that may cause disruption of breeding, migration, wintering, foraging, and other behavioral activities.
- Exposure to contaminants, which can have adverse effects on wildlife.

General Fish and Wildlife

In general, effects from geothermal development on common, widespread species, such as many small rodents, amphibians, and reptiles, would have impacts on individuals in localized areas. Many species are mobile, adaptable to small local changes to their environment, and are generally resilient to human disturbance. As such, geothermal development on the scale anticipated in the decision area would be unlikely to have population-level effects on these species.

Geothermal projects could cause groundwater withdrawal, which could affect water availability for vegetation. In the worst case scenario, vegetation that is affected by groundwater withdrawal could die due to lack of water availability, and the area could change vegetation composition or weed invasion could be facilitated. This would then affect the wildlife that depend upon these vegetation communities and could displace species to nearby or less suitable habitats.

Habitat quality could decline through loss, fragmentation, and degradation (e.g., increased dust and introduction or spread of invasive, nonnative species) caused by project construction. Dust and invasive species could lower the habitat value of the area by reducing habitat productivity and vigor and by displacing native species, respectively. Wildlife would be permanently displaced from the area, preventing them from using the site for foraging, breeding, wintering, and shelter. Acres of potential permanent habitat loss are presented under each decision area below.

Fragmentation would affect wildlife by altering how wildlife species use the habitat. Fragmentation can separate wildlife populations into smaller populations, making them more vulnerable to predation, drought, and disease and limiting genetic diversity within breeding groups. Movement between habitat tracts is more difficult after fragmentation and could affect movement within existing metapopulations. Roads have been shown to impede the movements of invertebrates, reptiles, and small and large mammals (Strittholt et al. 2006). Habitat fragmentation can create increased edges for access by predators and invasive species and can facilitate access by hunters, reducing the density and diversity of wildlife species found in the original habitat (Anderson et al. 1977). Habitat fragmentation and degradation is considered a causal factor for the decline in sage-grouse throughout most of its range (Strittholt et al. 2006).

Animals displaced by fragmentation would occupy nearby habitats, which could lead to an increase in competition for resources and result in decreased health and potentially death for less fit individuals. The impacts resulting from displacement after habitat removal and fragmentation depend on many factors, including the sensitivity of a species to edge and area effects, the duration and rate of habitat loss and fragmentation, and the proximity of a chosen habitat to the disturbed area (Hagan et al. 1996).

Low-level noise from power plant operation could have long-term effects on wildlife, causing them to avoid the area, or potentially putting chronic stress on animals, affecting their energy budget, reproduction, and long term survival (Radle 2007). Acoustical cues play a dominant role in sexual communication, territory defense, habitat quality assessment, and predator-prey interactions (Barber et al. 2009a), and may be impacted by low-level noise. For example, noise could interfere with bats that use echolocation to detect prey species. Studies have documented substantial changes in foraging and anti-predator behavior, reproductive success, density, and community structure in response to noise (Barber et al. 2009b). Given the predicted maximum extent of disturbance, the likelihood of extensive habitat loss or population-level effects on species is low.

Fish and Aquatic Biota

Impacts on fish and aquatic biota, including macroinvertebrates, from geothermal projects are, in most cases, directly linked to impacts on riparian and wetland habitats. Impacts would result primarily from activities occurring near or in water bodies. Potential causes include ground disturbance, vegetation removal, groundwater withdrawal, road construction and excavation, structure and other facility installation (e.g., transmission towers or pipelines), and release of water contaminants. The effects of such actions could include changes in hydrology, increased turbidity, changes in water quality (e.g., temperature, dissolved oxygen, pollutants), loss of riparian vegetation (an indirect aquatic food source), restriction of fish movement and migration, and changes in predator and human use of the aquatic habitat. This could cause reduced survivorship or increased susceptibility to disease or predation. Further, it would make areas uninhabitable, and could cause fish and aquatic biota to avoid previously suitable areas, thus causing potential population pressure or increased competition in other areas. Impacts would vary in severity based on the type of aquatic habitat, the density, type, and number of species, and the method and stage of geothermal development. Such impacts on fish and biota would be minimized through the leasing stipulations outlined in Appendix A, which specifically call for NSO of water bodies, riparian areas, playas, 100-year floodplains, and a 300-foot buffer for Lahontan cutthroat trout habitat as well as a CSU that would be applied to a 500-foot buffer area for riparian and wetland vegetation.

Big Game

While impacts from geothermal development are not yet well-researched, impacts are likely to be similar to those from oil and gas development, as many of the facilities would be similar. Studies have shown that roads and oil and gas development affect terrestrial wildlife, particularly big game species (Rowland et al. 2004; Trombulak and Frissell 2000). Impacts include those stated in the 2008 Geothermal PEIS, such as weed spread, habitat degradation, injury or mortality, and noise. Other impacts include increased daily movements and home range (Rowland et al. 2004). Such increases in movement and stress levels would

cause individuals to expend more energy, which could impact reproductive success or susceptibility to mortality, predation, or disease. Species have also been shown to avoid habitat extending to distances of over a mile from a source of disturbance (WGFD 2010). Mule deer were less likely to occupy areas in close proximity to well pads than those farther away, and no evidence of well pad acclimation occurred over time (Sawyer et al. 2005). Mule deer were less likely to use habitat within 1.7 to 2.3 miles of well pads, suggesting that indirect habitat loss may be substantially greater than direct habitat losses (Sawyer et al. 2005). Impacts are greater in areas with high densities of well pads, roads, facilities, and high traffic (WGFD 2010). Such impacts could occur as a result of geothermal development within the SLRA. However, given the maximum extent of disturbance that the RFDS predicts, the likelihood of extensive habitat fragmentation or population-level effects on big game species is low.

Pronghorn antelope require extensive areas for both summer and winter browse and are sensitive to human disturbance. As such, geothermal development proposed near or within pronghorn habitat could impact local populations.

Mule deer are widespread throughout the planning area, and population numbers are large. As a result, development of geothermal facilities could impact this species; if projects led to the loss, degradation, or disturbance of severe winter habitat or calving areas, population-level effects could occur due to reduced survivorship.

Migratory Birds and Bats

In general, bird species would be most sensitive to geothermal development, particularly any construction activities, drilling, or increased human presence, during summer months, when bird use of the planning area is high and birds are breeding and rearing young. In addition, construction of transmission lines would lead to collisions and provide for perching and additional predation.

Bats could also be impacted by geothermal development, as the large fans and transmission or distribution lines could present flight hazards. The fans would not only be a threat due to their physical structure, but also because they blow a strong vertical flume of exhaust, which could affect bat flight patterns. In addition, any pesticides used during site preparation or development could reduce the prey base for bats. Noise could impact bat location capabilities.

4.12.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative 1

Based on the RFDS, a total of three to six power plants would be constructed. As a result, up to 2,202 acres would be permanently disturbed within the Bridgeport Geothermal Decision Area, causing impacts as described in Section 4.11.3. The greatest impacts from geothermal leasing are likely in the pinyon-juniper and sagebrush vegetation communities, since these communities have

the greatest acreage in the decision area. As a result, the species that depend on these habitat types would be the most likely to be affected. The following stipulations would be applied to reduce the likelihood of impacts on species and habitats:

- NSO within water bodies, riparian areas, wetlands, playas, and 10-year floodplains, with a 300-foot buffer for historic Lahontan cutthroat trout habitat; and
- CSU within 500 feet of riparian or wetland vegetation.

These stipulations would help to reduce impacts on fish and aquatic biota such as changes to habitat caused by removal of streamside cover, erosion and sedimentation of waterways, and reductions in water quality due to increased turbidity or chemical inputs. NSOs for other resources would provide incidental protection to fish and wildlife and their habitats by prohibiting surface-disturbing activities in these areas. NSOs for sage-grouse would be applied on up to approximately 169,600 acres, which would protect habitat from removal and wildlife from disturbance in these areas. In addition, ground-disturbing activities would be prohibited during migratory bird nesting season unless a preconstruction nest survey determines that the area is clear of nests. This would reduce the likelihood for disruption of nesting birds, nest abandonment, and reduced survivorship of eggs and chicks.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be protected with an NSO stipulation. Although the acres subject to NSO stipulations would be greater than under Alternative 1, the acres cannot be quantified at this time. The locations of sage-grouse nesting and early brood rearing habitat would need to be field verified during future phases of leasing and development.

Alternative 3

Under Alternative 3, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on the LRMPs. The number of acres that could impact fish and wildlife is unknown; however, impacts would be site-specific and similar to the impacts under the four phases of geothermal development identified in the 2008 Geothermal PEIS and Section 4.11.3. Under this alternative, no regionally specific list of stipulations would be used to serve as consistent guidance for all future geothermal leasing and development. This would result in fragmented and segregated planning for wildlife and wildlife habitats which often exponentially increases impacts. Development of the individual leasing approvals and stipulations would also vary depending on the site and would delay application processing time.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 2 and would incorporate the most recent science known about the greater sage-grouse. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area. By imposing greater limitations for the siting of geothermal plants and infrastructure, impacts on fish and wildlife and their habitats would be reduced.

4.12.5 Potential Impacts for the Austin Geothermal Decision Area**Alternative 1**

Based on the RFDS, a total of one plant would be constructed. As a result, up to 367 acres would be permanently disturbed within the Austin Geothermal Decision Area, causing impacts as described in Section 4.11.3. The greatest impacts from geothermal leasing are likely in the sagebrush vegetation community, since this community has the greatest acreage in the decision area. As a result, the species that depend on this habitat type would be the most likely to be affected. NSOs would be applied, which would protect habitats and wildlife from disturbance in these areas. There are no water bodies, riparian areas, or wetlands within the decision area, so there would be no impacts on species that depend on these habitats.

Timing limitations would be as described for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts under Alternative 2 would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 3

Under Alternative 3, impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO and would incorporate the most recent science known about the greater sage-grouse. The NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area. By imposing greater limitations for the siting of geothermal plants and infrastructure, impacts on fish and wildlife and their habitats would be reduced.

4.12.6 Potential Impacts for the Ely Geothermal Decision Area

Alternative 1

Based on the RFDS, a total of one plant would be constructed. As a result, up to 367 acres would be permanently disturbed within the Ely Geothermal Decision Area, causing impacts as described in Section 4.11.3. The greatest impacts from geothermal leasing are likely in the sagebrush vegetation community, since this community has the greatest acreage in the decision area. As a result, the species that depend on this habitat type would be the most likely to be affected. NSOs for sage-grouse would be applied on 3,300 acres, which would protect habitats and wildlife from disturbance in these areas. There are no water bodies, riparian areas, or wetlands within the decision area, so there would be no impacts on species that depend on these habitats.

Elk are found only in the Ely Geothermal Decision Area and need large areas of undisturbed severe winter habitat during harsh winters. As a result, elk are likely to be affected by the development of geothermal facilities. Population-level effects could result from development in elk critical winter habitat or calving areas.

Timing limitations would be as described for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts under Alternative 2 would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 3

Under Alternative 3, impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would decrease the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area. This could allow for greater impacts on fish and wildlife and their habitats.

4.12.7 Potential Impacts for the Tonopah Geothermal Decision Area

Alternative 1

Based on the RFDS, a total of one plant would be constructed. As a result, up to 367 acres would be permanently disturbed within the Tonopah Geothermal Decision Area, causing impacts as described in Section 4.11.3. The greatest impacts from geothermal leasing are likely in the salt desert shrub and semi desert shrub vegetation community, since this community has the greatest acreage in the decision area. As a result, the species that depend on these

habitat types would be the most likely to be affected. No NSO stipulations would be applied within the decision area. There are no water bodies, riparian areas, or wetlands within the decision area, so there would be no impacts on species that depend on these habitats.

Timing limitations would be as described for the Bridgeport Geothermal Decision Area.

Indirect impacts from geothermal development include the potential for effects on trout and endemic fish in the White River and Ellison Creek. Impacts could include drawdown of the water table, which would affect flows in these waterbodies, potentially making them less suitable for aquatic biota inhabiting these areas. Impacts on populations include reduced survivorship and increased susceptibility to disease or predation. In addition, the potential reduction in suitable habitat could increase population pressure or competition in areas that remain inhabitable.

Alternative 2

Impacts under Alternative 2 would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 3

Under Alternative 3, impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse would increase the acreage subject to NSO and would incorporate the most recent science known about the greater sage-grouse. The NSO stipulations for sage-grouse would apply the entire decision area. This would prevent impacts on fish and wildlife and their habitats.

4.13 THREATENED, ENDANGERED, AND SPECIAL STATUS SPECIES

This section discusses impacts on threatened, endangered, and special status species from the alternatives described in Chapter 2.

4.13.1 Scoping Comments on the Resource

The following scoping comments and issues were submitted during the scoping process:

- Commenters were concerned with potential impacts on cold-water native game and non-game fishes, threatened and endangered species, as well as warm water fishes – specifically, sport and protected endemic fishery concerns in the White River, Ellison Creek, and Smith Creek.

- Commenters were concerned with impacts on sage-grouse and recommended that the Forest Service follow the guidance and standards described in the “Nevada Energy and Infrastructure Development Standards to Conserve Greater Sage-grouse Populations and Their Habitats” for leasing, exploration, production, and reclamation. Specifically for the Humboldt-Toiyabe Geothermal Leasing Project, the Forest Service should remove all parcels from leasing within habitat categories 1 through 3 of the Nevada Governor’s Sage-grouse Conservation Team’s habitat categorization map.
- Commenters recommended that all lands that provide habitat for rare, sensitive, or declining species habitat as well as habitat recovery areas needed for long-term population viability should be identified and classified as off-limits to energy development intrusions.

Issue: Impacts on threatened, endangered, or sensitive species related to geothermal leasing decisions.

4.13.2 How Resource Impacts Were Evaluated

Methodology

The methodology for Special Status Species impact analysis is incorporated by reference from the 2008 Geothermal PEIS (BLM and Forest Service 2008). The analysis presented is largely qualitative due to the lack of data or uncertainty in existing data on special status species within the planning area. Additional methodology specific to this EIS includes analysis using GIS, when available. Since most special status species are associated with specific vegetation communities, impacts on vegetation, as described in Section 4.11, would also likely impact special status species. In addition, many of the impacts on fish and wildlife associated with geothermal development described in Section 4.12 would also apply to special status species.

A biological assessment is being prepared to analyze potential effects on federally listed and proposed species. A biological evaluation was prepared to analyze potential effects on Forest Service sensitive species.

Indicators

Potential impacts on federally threatened, endangered, or proposed species, as well as special status species, could occur if reasonably foreseeable future actions were to:

- Violate the ESA, Bald and Golden Eagle Protection Act, Migratory Bird Treaty Act, or applicable state laws or Forest Service regulations; or

- Adversely affect any individual or population of federally listed or proposed species.

Assumptions

This analysis assumes the following:

- Ground-disturbing activities could lead to modification (positive or negative) of habitat and loss or gain of individuals, depending on the amount of area disturbed, nature of the disturbance, the species affected, and the location of the disturbance.
- Impacts on special status species would be more significant than impacts on common species because population viability is already uncertain for special status species.
- The US Fish and Wildlife Service would be consulted for any actions that have a potential to affect any federally listed endangered, threatened, or proposed species.

4.13.3 Common Impacts Associated with Geothermal Development

The information presented in the Common Impacts on Special Status Species Associated with Geothermal Development section of the 2008 Geothermal PEIS (BLM and Forest Service 2008) is incorporated by reference and summarized here. However, additional information specific to this EIS includes consideration of the particular special status species and habitats found in the planning area.

Due to the inability to predict the location, scope, scale, and timing of future development, the following impact analysis provides a general description of common impacts on threatened and endangered and special status species from geothermal resource development. Geothermal exploration, drilling operations, utilization, and reclamation and abandonment could affect threatened, endangered, and sensitive species in the same manner that vegetation, wildlife, and aquatic resources could be affected (see Section 4.12, Fish and Wildlife). Special status species could be affected as a result of 1) habitat disturbance, 2) the introduction of invasive vegetation, 3) injury or mortality, 4) erosion and runoff, 5) fugitive dust, 6) noise, 7) exposure to contaminants, and 8) interference with behavioral activities. Which species may be at risk to construction-related effects would depend on the project location and specific habitat present at or near the site.

An important distinction regarding impacts on special status species is that impacts on small localized areas or affecting only a few individuals can have adverse impacts on special status species. Many special status species are dependent on unique habitats or have small remaining populations. Impacts that directly affect these unique habitats or individuals, even when small, can have significant impacts on special status species.

Greater Sage-Grouse

Most concerns about the effects of geothermal development on sage-grouse have focused on the potential impacts associated with reducing, fragmenting, and modifying grassland and shrubland habitats, particularly sagebrush. Impacts from habitat fragmentation are described above in Section 4.12.3. Geothermal facilities, well pads, transmission lines, pipelines, and access roads may adversely affect habitats important to sage-grouse by causing fragmentation, reducing habitat value, or reducing the amount of habitat available (Connelly et al. 2004). Facilities could prevent movement and genetic flow between existing metapopulations. Reduced gene flow could cause inbreeding, leading to physical and health defects. Geothermal facilities, transmission lines, pipelines, and other structures can also provide perches and nesting areas for raptors and corvids that may prey upon sage-grouse. Sage-grouse are also susceptible to vehicular collision along dirt roads because they are sometimes attracted to the dirt roads where they might take dust baths (Strittholt et al. 2000).

Recent studies have shown effects from development, recreation, and roads on greater sage-grouse. Impacts include reduced nest initiation rates (Lyon and Anderson 2003), avoidance of developed areas and increases in movement (Lyon and Anderson 2003; Holloran 2005; Crompton 2005; Doherty et al. 2008), reduced attendance of males at lek sites (Holloran 2005; Walker et al. 2007; Crompton 2005), and reduced survivorship (Crompton 2005). Impacts occur in lekking, nesting, brood rearing, and winter habitat (Crompton 2005; Doherty et al. 2008), and negative effects have been shown to occur from 0.5 mile to 4 miles away from oil and gas development (Walker et al. 2007; Naugle et al. 2009). It is possible that sage-grouse may repopulate developed areas after oil and gas operation ends, but long-term studies have not yet been conducted (Connelly et al. 2000).

Bighorn Sheep

The probability of bighorn sheep being affected by geothermal projects is low since bighorn sheep are generally found in steep, rocky, remote habitats that geothermal developers would normally avoid. However, if geothermal development is proposed within or near either severe wintering habitat or calving areas, local populations could be affected.

4.13.4 Potential Impacts for the Bridgeport Geothermal Decision Area**Alternative 1**

Based on the RFDS, a total of three to six power plants would be constructed. As a result, up to 2,202 acres would be permanently disturbed within the Bridgeport Geothermal Decision Area, causing impacts as described in Section 4.11.3. The greatest impacts from geothermal leasing are likely in the pinyon-juniper and sagebrush vegetation communities, since these communities have the greatest acreage in the decision area. As a result, special status species that rely on these communities would be the most likely to be affected, such as

pygmy rabbit, greater sage-grouse, Bodie Hills rockcress, and Webber ivesia. See Section 3.13 for all special status species' habitat requirements.

The following stipulations would be applied to reduce the likelihood of impacts on special status species and habitats:

- NSO within water bodies, riparian areas, wetlands, playas, and 10-year floodplains, with a 300-foot buffer for historic Lahontan cutthroat trout habitat;
- CSU within 500 feet of riparian or wetland vegetation;
- CSU within habitat for listed, proposed or candidate species and within critical habitat; and
- CSU within habitat for Forest Service Sensitive or other special status species.

These stipulations would help to reduce impacts on all special status species from surface-disturbing activities. NSOs for other resources would provide incidental protection to special status species and their habitats by prohibiting surface-disturbing activities in these areas. NSOs for sage-grouse would be applied on up to approximately 169,600 acres, which would protect habitat from removal and special status wildlife from disturbance in these areas. In addition, no ground disturbing activities would be allowed during migratory bird nesting season unless a nest survey is completed prior to ground disturbance. This would reduce the likelihood for disruption of nesting special status birds, nest abandonment, and reduced survivorship of eggs and chicks

To protect sage-grouse, the Forest Service would require an NSO within three miles of active leks (Appendix A).

Alternative 2

Under Alternative 2, an NSO would be applied within three miles of active leks and within active sage-grouse nesting and active early brood-rearing habitat, if it falls outside the three mile radius from a lek. This would provide additional protection to sage-grouse habitat from disturbance in these areas. Although the acres subject to NSO stipulations would be greater than under Alternative 1, the exact acres cannot be quantified at this time. The locations of sage-grouse nesting and early brood rearing habitat would need to be field verified during future phases of leasing and development.

Alternative 3

Under Alternative 3, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on the LRMP. The number of acres that could impact special status species is unknown; however, impacts would be site-specific and similar to the

impacts under the four phases of geothermal development identified in the PEIS and Section 4.13.3. Under this alternative, no regionally specific list of stipulations would be used to serve as consistent guidance for all future geothermal leasing and development. This would result in fragmented and segregated planning for special status species and potential habitats which often exponentially increases impacts. Development of the individual leasing approvals and stipulations would also continue to vary depending on the site and would delay application processing time.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO and would incorporate the most recent science known about the greater sage-grouse. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area. By imposing greater limitations for the siting of geothermal plants and infrastructure, impacts on special status species and their habitats would be reduced.

4.13.5 Potential Impacts for the Austin Geothermal Decision Area

Alternative 1

Based on the RFDS, a total of one plant would be constructed. As a result, up to 367 acres would be permanently disturbed within the Austin Geothermal Decision Area, causing impacts as described in Section 4.13.3. The greatest impacts from geothermal leasing are likely in the sagebrush vegetation community, since this community has the greatest acreage in the decision area. As a result, the special status species that depend on this habitat type would be the most likely to be affected, such as pygmy rabbit, greater sage-grouse, and Toquima milkvetch. See Section 3.13 for all special status species' habitat requirements. NSOs would be applied, which would protect habitats and special status species from disturbance in these areas. There are no water bodies, riparian areas, or wetlands within the decision area, so there would be no impacts on species that depend on these habitats.

NSO, CSU, and TL stipulations would be as described for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts on sage-grouse would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 3

Under Alternative 3, impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO and would incorporate the most recent science known about the greater sage-grouse. The NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area. By imposing greater limitations for the siting of geothermal plants and infrastructure, impacts on special status species and their habitats would be reduced.

4.13.6 Potential Impacts for the Ely Geothermal Decision Area**Alternative 1**

Based on the RFDS, a total of one plant would be constructed. As a result, up to 367 acres would be permanently disturbed within the Ely Geothermal Decision Area, causing impacts as described in Section 4.13.3. The greatest impacts from geothermal leasing are likely in the sagebrush vegetation community, since this community has the greatest acreage in the decision area. As a result, the special status species that depend on this habitat type would be the most likely to be affected. See Section 3.13 for all special status species' habitat requirements. NSOs for sage-grouse would be applied on 3,300 acres, which would protect habitats and special status species from disturbance in these areas. There are no water bodies, riparian areas, or wetlands within the decision area, so there would be no impacts on species that depend on these habitats.

NSO, CSU, and TL stipulations would be as described for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts on sage-grouse would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 3

Under Alternative 3, impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would decrease the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area. This could allow for greater impacts on special status species and their habitats.

4.13.7 Potential Impacts for the Tonopah Geothermal Decision Area

Alternative 1

Based on the RFDS, a total of one plant would be constructed. As a result, up to 367 acres would be permanently disturbed within the Tonopah Geothermal Decision Area, causing impacts as described in Section 4.13.3. The greatest impacts from geothermal leasing are likely in the salt desert shrub and semi desert shrub vegetation community, since this community has the greatest acreage in the decision area. As a result, the special status species that depend on these habitat types would be the most likely to be affected, such as foraging sensitive bats and birds, and rare plants such as Eastwood milkweed. See Section 3.13 for all special status species' habitat requirements. There are no water bodies, riparian areas, or wetlands within the decision area, so there would be no impacts on species that depend on these habitats.

NSO, CSU, and TL stipulations would be as described for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts would be similar to those described for Alternative 1. Impacts on sage-grouse would be as described for the Bridgeport Geothermal Decision Area.

Alternative 3

Under Alternative 3, impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse would increase the acreage subject to NSO and would incorporate the most recent science known about the greater sage-grouse. The NSO stipulations for sage-grouse would apply to the entire decision area. This would prevent impacts on special status species and their habitats.

4.14 WILD HORSES AND BURROS

This section discusses impacts on wild horses and burros from the alternatives described in Chapter 2.

4.14.1 Scoping Comments on the Resource

Commenters were concerned with direct or indirect impacts on wild horse and burro territories from geothermal leasing. Concerns also mentioned impacts on wild horses and burros within the planning area, including the potential for loss of range and contamination of food and water sources on which wild horse and burros in the region depend.

4.14.2 How Resource Impacts Were Evaluated

Methodology

The methods used to determine potential effects of geothermal development on Wild Horses and Burros were evaluated by a review of wild horse and burro territories GIS data overlain on the four decision areas.

Methods also include consideration of the types of impacts that geothermal projects may have on wild horse and burro populations and describing both the impacts and the relative land areas that could be impacted by anticipated future actions consistent with the alternatives described in Chapter 2.

Indicators

Potential impacts on wild horses and burros could occur if reasonably foreseeable future actions were to result in the following:

- Conflict with management goals and objectives set forth by the Forest Service for protecting and managing wild horses and burros; or
- Interfere with the movement of wild horses and burros.

4.14.3 Common Impacts Associated with Geothermal Development

Due to the inability to predict the location, scope, scale, and timing of future development, the following impact analysis provides a general description of common impacts on wild horses and burros from geothermal resource development. Issuing geothermal leases would not disturb wild horse and burro populations or habitat, so the discussion is limited to impacts related to anticipated future actions.

Impacts from activities associated with the four phases of geothermal development would include the temporary or long-term loss of forage, restricted access to water sources, harassment of horses or burros, and possible fragmentation of herd areas or herd distribution.

4.14.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative 1

Under Alternative 1, the Forest Service would consent to lease up to approximately 602,115 acres of National Forest System lands within the Bridgeport Geothermal Decision Area and up to 2,202 acres would be disturbed. There are two wild horse and burro territories in the decision area. The overall Powell Mountain Territory has a managed herd size of 29, and the Montgomery Pass Territory has a herd management limit of 75. Alternative 1 would not have any direct impact on Wild Horses and Burros; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in impacts. Impacts from future development

would be similar in nature and type as those described previously for common impacts associated with geothermal development. Based on the RFD for the decision area, with a maximum of six power plants disturbing 367 acres each, impacts on wild horses and burros over the 602,115-acre decision area would be minimal.

In addition, leasing would include stipulations from Chapter 2 of the 2008 Geothermal PEIS and other stipulations determined to be reasonable and necessary to protect Wild Horses and Burros as outlined in Appendix A. BMPs included in Appendix C of the PEIS would also be implemented.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be protected with an NSO stipulation. The NSO stipulations for sage-grouse would apply to approximately 169,600 acres within the decision area.

Alternative 3

Alternative 3 would not make a consent determination for lands within the decision area. Processing of geothermal lease applications and nominations would continue; however, they would be evaluated on a case-by-case basis under separate NEPA analyses.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area.

4.14.5 Potential Impacts for the Austin Geothermal Decision Area

Alternative 1

Wild horse and burro territories are not present in the Austin Geothermal Decision Area; therefore, Alternative 1 would not have any direct impact on Wild Horses and Burros.

Alternative 2

Wild horse and burro territories are not present in the Austin Geothermal Decision Area; therefore, Alternative 2 would not have any direct impact on Wild Horses and Burros.

Alternative 3

Wild horse and burro territories are not present in the Austin Geothermal Decision Area; therefore, Alternative 3 would not have any direct impact on Wild Horses and Burros.

Alternative 4 (Preferred Alternative)

Wild horse and burro territories are not present in the Austin Geothermal Decision Area; therefore, Alternative 4 would not have any direct impact on Wild Horses and Burros.

4.14.6 Potential Impacts for the Ely Geothermal Decision Area***Alternative 1***

Wild horse and burro territories are not present in the Ely Geothermal Decision Area; therefore, Alternative 1 would not have any direct impact on Wild Horses and Burros.

Alternative 2

Wild horse and burro territories are not present in the Ely Geothermal Decision Area; therefore, Alternative 2 would not have any direct impact on Wild Horses and Burros.

Alternative 3

Wild horse and burro territories are not present in the Ely Geothermal Decision Area; therefore, Alternative 3 would not have any direct impact on Wild Horses and Burros.

Alternative 4 (Preferred Alternative)

Wild horse and burro territories are not present in the Ely Geothermal Decision Area; therefore, Alternative 2 would not have any direct impact on Wild Horses and Burros.

4.14.7 Potential Impacts for the Tonopah Geothermal Decision Area***Alternative 1***

Wild horse and burro territories are not present in the Tonopah Geothermal Decision Area; therefore, Alternative 1 would not have any direct impact on Wild Horses and Burros.

Alternative 2

Wild horse and burro territories are not present in the Tonopah Geothermal Decision Area; therefore, Alternative 2 would not have any direct impact on Wild Horses and Burros.

Alternative 3

Wild horse and burro territories are not present in the Tonopah Geothermal Decision Area; therefore, Alternative 3 and RFD would not have any direct impact on Wild Horses and Burros.

Alternative 4 (Preferred Alternative)

Wild horse and burro territories are not present in the Tonopah Geothermal Decision Area; therefore, Alternative 4 would not have any direct impact on Wild Horses and Burros.

4.15 LIVESTOCK GRAZING

This section discusses impacts on livestock grazing from the alternatives described in Chapter 2.

4.15.1 Scoping Comments on the Resource

There were no public comments specifically addressing livestock grazing.

4.15.2 How Resource Impacts Were Evaluated***Methodology***

The methods to determine the potential effects on livestock grazing included review of Forest Service grazing allotment data, specifically the size of allotments in acres and AUMs within the four decision areas.

Indicators

Potential impacts on livestock grazing could occur if reasonably foreseeable future actions were to result in the following:

- Decrease acreages available to grazing;
- Decrease AUM number or forage; or
- Cause harassment or death of livestock.

4.15.3 Common Impacts Associated with Geothermal Development

Issuing a geothermal lease does not involve ground-disturbing activities or any type of construction, so there would be no direct impact on livestock grazing. Impacts would result from activities pursued after leasing. Due to the inability to predict the location, scope, scale, and timing of future development, the following impact analysis provides a general description of common impacts on livestock grazing from geothermal resource development.

A detailed description of geothermal development operations relative to livestock grazing resources are described in detail in the 2008 Geothermal PEIS, the phases of geothermal development including exploration, drilling operations, utilization, and reclamation and abandonment are also discussed in detailed in the PEIS. Impacts on livestock grazing from the phases of geothermal development would include temporary or permanent reduction in forage and AUMs, and may lead to shifts in grazing distribution or season of use.

4.15.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative 1

Under Alternative 1, the Forest Service would consent to lease up to approximately 602,115 acres of National Forest System lands. Alternative 1 would not have any direct impact on livestock grazing; however, geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. There are 31 grazing allotments ranging in size from 198 acres to 68,439 acres within the Bridgeport Geothermal Decision Area. Based on the RFDS for the decision area and a total maximum disturbance of 2,202 acres, there is potential for impacts on grazing allotments, including a reduction in forage and possible reductions in AUMs. However, the size and location of each geothermal project is not known and individual project related disturbance of approximately 367 acres would have minimal impacts on all but the smallest grazing allotments.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be subject to NSO stipulations. The NSO stipulations for sage-grouse would apply to approximately 169,600 acres within the decision area.

Alternative 3

Alternative 3 would not make consent determination on lands within the decision area. Processing of geothermal lease applications and nominations would continue; however, they would be evaluated on a case-by-case basis under separate NEPA analyses. Alternative 3 would not result in impacts on livestock grazing resources. However, leasing on a case-by-case basis could result in fragmentation of future development and development of the individual leasing approvals and stipulations would also continue to vary depending on the site and would delay application processing time.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area.

4.15.5 Potential Impacts for the Austin Geothermal Decision Area

Alternative 1

Under Alternative 1, the Forest Service would consent to lease up to approximately 3,961 acres of National Forest System lands. Alternative 1 would not have any direct impact on livestock grazing resources; however, anticipated geothermal exploration and development activities likely to follow leasing would

potentially result in such impacts. There is one grazing allotment in the Austin Geothermal Decision Area covering 3,920 acres, and the allotment has no known active AUMs. Based on the RFD with 367 acres of disturbance and the fact that there are no active AUMs in the decision area, no impacts on livestock grazing are anticipated.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be subject to NSO stipulations. The NSO stipulations for sage-grouse would apply to approximately 1,600 acres within the decision area.

Alternative 3

Impacts associated with Alternative 3 would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts on livestock grazing would be similar to those described for the Bridgeport Geothermal Decision Area. However, the NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area.

4.15.6 Potential Impacts for the Ely Geothermal Decision Area

Alternative 1

Under Alternative 1, the Forest Service would consent to lease up to approximately 3,538 acres of National Forest System lands. Alternative 1 would not have any direct impact on livestock grazing resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. There is one grazing allotment in the Ely Geothermal Decision Area covering 3,525 acres, and the allotment has no known active AUMs. Based on the RFD with 367 acres of disturbance and the fact that there are no active AUMs in the decision area, no impacts on livestock grazing are anticipated.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be subject to NSO stipulations. The NSO stipulations for sage-grouse would apply to approximately 3,300 acres within the decision area.

Alternative 3

Impacts associated with Alternative 3 would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse would decrease the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area.

4.15.7 Potential Impacts for the Tonopah Geothermal Decision Area**Alternative 1**

Under Alternative 1, the Forest Service would consent to lease up to approximately 166 acres of National Forest System lands. Alternative 1 would not have any direct impact on livestock grazing resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. There are no known grazing allotments in the Tonopah Geothermal Decision Area therefore, there would be no impacts on livestock grazing.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for Native American concerns would increase the acreage that would be subject to NSO stipulations.

Alternative 3

Impacts associated with Alternative 3 would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to the entire decision area. Therefore, impacts on livestock grazing would be minimal.

4.16 CULTURAL RESOURCES

This section discusses impacts on cultural resources from the alternatives described in Chapter 2.

4.16.1 Scoping Comments on the Resource

The following scoping comments and issues were submitted and identified during the scoping process:

- Commenters noted that geothermal leasing could potentially affect one or two national historic trails administered by the National Park Service.

Issue: Impacts on cultural resources and historic trails during exploration and development. This includes the potential for the following:

- disturbance and removal of significant and/or NRHP-eligible prehistoric and Historic period sites;
- loss of cultural practice opportunities for Native Americans (e.g., traditional plant gathering, traditional sacred places, travel routes);
- loss of scientific data and research potential;
- loss of Native American cultural heritage and values; and
- loss of historic viewshed and Native American cultural heritage and values.

4.16.2 How Resource Impacts Were Evaluated

Methodology

Cultural resources are past and present expressions of human culture and history in the physical environment. The term “cultural resource” can refer to archaeological, historical, and architectural sites, structures, or places with important public and scientific uses, and may include locations (i.e., sites, natural features, resource gathering areas, or places) of traditional cultural or religious importance to specified social and/or cultural groups.

Consent to leasing and leasing decisions do not grant any rights or authorize any activities affecting cultural resources, therefore the impact analysis focuses on the anticipated future actions consistent with the implementation of the alternatives described in Chapter 2, as well as considering the proposed stipulations included in Appendix A. Existing conditions concerning cultural resources are described in Section 3.16.

Cultural resource baseline information was reviewed for current understanding of known resources and to determine the condition of the resources. Also, all laws pertinent to determining effects on cultural resources (e.g., NHPA) were considered and included in criteria for determining impacts. This known information was overlain with the actions found under each alternative in Chapter 2, and conclusions were drawn based on an understanding of how these types of actions may affect the known and potentially discoverable resources.

Indicators

Impacts on cultural resources occur when there is damage or loss of cultural resources or their settings. Under NEPA, impacts on cultural resources are assessed by applying the criteria of adverse effect as defined in the implementing regulations for Section 106 of the NHPA (36 CFR 800).

An adverse effect is found when an action may alter the characteristics of a historic property that qualify it for inclusion in the NRHP in a manner that would diminish the integrity of the property’s location, design, setting, workmanship, feeling, or association. Adverse effects may include reasonably

foreseeable effects caused by the action that may occur later in time, be farther removed in distance, or be cumulative (36 CFR 800.5).

Additionally, assessment of effects involving Native American or other traditional community, cultural, or religious practices, resources, or areas requires focused consultation with the affected group and impact analysis would be informed by said consultation.

For the purposes of this analysis, indicators for determining effects on cultural resources include asking whether the action would:

- Conflict with management goals and objectives that sustain cultural resources and their qualities set forth in the Humboldt and Toiyabe LRMPs;
- Result in proposed uses that are incompatible with maintaining and identifying cultural resources and their qualities;
- Cause physical destruction or damage to all or part of the property;
- Alter a property, by restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation, and provision of handicapped access, that is not consistent with the Secretary of the Interior's standards for the treatment of historic properties (36 CFR 68) and applicable guidelines;
- Remove the property from its historic location;
- Change the character of the property's use or physical features within a property's setting that contribute to its historic significance (e.g., isolating the property from its setting);
- Introduce visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic features;
- Neglect a property, which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe; or
- Disturb any human remains, including those interred outside of formal cemeteries.

Any of the above indicators would contribute to an adverse effect (under the NHPA) to a cultural resource if it is listed on or eligible for listing on the NRHP or if it is an area of importance to Native American or other traditional community. If a site is determined to be eligible for listing or is listed on the NRHP, any physical disturbance would also constitute a significant impact under NEPA. If a site is determined to be ineligible for listing, then any disturbance may be considered substantial but would not be significant under NEPA or "adverse" under NHPA. Mitigation measures would be implemented by the

applicant in coordination with applicable responsible agencies to resolve adverse impacts on NRHP-eligible properties.

Impacts can be direct or indirect in nature. In practice, a “direct effect” would be limited to the direct physical disturbance of a historic property, for example, destroying a historic property as a result of construction needed to build the project. Indirect effects could include visual or audible intrusion as a result of the project being built or increased risk of looting as a result of better access and increased visitation to the area.

Impacts on cultural resources are typically considered permanent as these resources are finite and disturbance of them, particularly archaeological sites, cannot be reversed. However, impacts on the historic landscape or the viewsheds of historic or other culturally significant areas can be temporary if projects do not permanently impact associated resources and are removed at a future date.

Assumptions

This analysis assumes the following:

- The criteria of adverse effect provide a general framework for identifying and determining the context and intensity of potential impacts on other categories of cultural resources, such as Native American or other traditional community, cultural, or religious practices or resources, if these are present. Assessment of effects on these resources requires focused consultation with the affected group.
- The Forest Service will follow the regulations at 36 CFR 800, Section 106 (including Native American consultation); therefore, adverse effects on cultural resources would be appropriately mitigated.
- Human occupation of North America over the last 10,000 years has left its mark on all landforms, and sites may be manifest on the surface or deeply buried. There may be areas of importance to contemporary Native Americans that are not readily identifiable outside of those communities.
- The information on cultural resources in the planning area is based on the results of industry and Forest Service inventory projects and depicts the relative potential for cultural resource sites within the planning area. However, as these data are geographically biased toward past project-oriented undertakings and cannot accurately predict where and how many resources may exist in unsurveyed areas, this analysis does not attempt to quantify affected resources.
- Cultural resource protection and mitigation measures apply to all proposed federal or federally assisted undertakings by the Forest

Service and to leases granted by BLM and would be applied at project design and implementation phases.

- Cultural resource inventories, either federal undertakings or related programs, would result in the continued identification of cultural resources. The cultural resource data acquired through these inventories and evaluations would increase overall knowledge and understanding of the distribution of cultural resources in the region.
- Impacts from future actions on known cultural resource sites from authorized uses would be mitigated after appropriate Section 106 and Nevada SHPO consultation requirements are met. Mitigation can include project cancellation, redesign, avoidance, or data recovery.
- There would be no findings of adverse effect from the proposed action or alternatives because consent to leasing would not result in ground disturbance. Future geothermal development phases would be subject to additional analysis under NEPA and adverse effects from such actions would be identified at that time.

The number of sites that could be affected by actions correlates with the degree, nature, depth, and quantity of surface disturbing activities within the planning area and the cultural sensitivity of the area.

4.16.3 Common Impacts Associated with Geothermal Development

The nature and characteristics of the direct and indirect impacts on cultural resources associated with geothermal development as a result of the decisions common to all action alternatives would be the same as those described in the 2008 Geothermal PEIS (BLM and Forest Service 2008) is incorporated by reference and summarized here.

Any activities that would involve surface disturbing activities would have direct and indirect impacts on cultural resources, including damaging, destroying, and/or displacing artifacts and features, and construction of modern features out of character with a historic setting. Damaging, displacing, and/or destroying cultural resources could include removing artifacts from their situational context, breaking artifacts, and/or shifting, obliterating, or excavating features without appropriate scientific recording.

Indirect impacts on cultural resources would include changing the character of the property's use or physical features within the property's setting that contribute to its historic significance (e.g., isolating the property from its setting) and introducing visual, atmospheric, or audible elements that diminish the integrity of the property's historic features. Construction of the geothermal plant(s), well pads, and associated facilities would place modern features onto a landscape that did not have them previously, thereby juxtaposing "modern" industrial features onto an historic landscape. Additionally, with the increased

human presence of site workers during all phases of geothermal development, there is the risk of illicit collection of surface artifacts resulting in a loss of scientific information.

The potential for undiscovered buried cultural resources and human remains exists despite previous archaeological surveys and investigations. Surface disturbing activities would directly impact undiscovered cultural resources and human remains by exposing buried material, resulting in inadvertent artifact destruction or loss of scientific context. Indirect impacts could result from the increased human presence from anticipated site workers, leading to possible illicit collection of newly exposed materials.

Reclamation of geothermal developments would eliminate the indirect viewshed or setting impacts for cultural resources. With reclamation practices, the natural and historic setting would be restored. Similar to impacts during earlier phases, the potential for undiscovered buried cultural materials and/or human remains continues to exist through reclamation and abandonment. Abandonment activities may expose buried materials, resulting in inadvertent artifact destruction or loss of scientific context; additionally, the increased presence of site employees may lead to illicit collection of exposed materials.

4.16.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative 1

The Forest Service would consent to lease up to approximately 602,115 acres of National Forest System lands in the Bridgeport Geothermal Decision Area and disturb up to 2,202 acres. Impacts of the nature and type described above would likely result should development occur. As there are many known cultural resources within the decision area and several eligible sites, there would be a high likelihood that these or unknown sites could be impacted as a result of geothermal development. This chance for discovery of unknown sites or impacts on known eligible sites would be lessened due to the small footprint for projects' surface disturbance. Most of the cultural resources that could be encountered could be avoided or mitigated to reduce geothermal development impacts. However, the magnitude and extent of impacts on cultural resources would ultimately depend on the current condition of the resources and their eligibility for the NRHP. However, impacts would be reduced by implementation of NSO and CSU stipulations outlined in Appendix A. In addition, if cultural resources are determined to be within the area of effect of proposed development, then other standard cultural resources stipulations (e.g., construction monitoring, avoidance requirements around sites, etc.) would be applied. Application of the 200 foot buffer around TCPs would also protect cultural resources from direct impacts associated with future development. The applied 200 foot buffer may afford some protection against visual, aural, and atmospheric intrusions, but to what extent would need to be determined at the time a project is proposed and based on the proposal's location.

Alternative 2

Impacts under this alternative would be similar in nature and type as those described under Common Impacts Associated with Geothermal Development and Alternative 1. However, under Alternative 2, the Forest Service would apply a one-mile buffer around TCPs, which would create a larger protection area around them and reduce the likelihood for impacts to low. There would not only be no direct impact from a potential development, the stricter stipulation under this alternative would also reduce indirect visual, aural, and atmospheric impacts. A development would be farther away from a TCP and therefore could be less visible and audible to an observer within the TCP. Also, the NSO stipulations for sage-grouse would apply to approximately 169,600 acres within the decision area.

Alternative 3

Under Alternative 3, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on the LRMPs. Issuing geothermal leases on a case-by-case basis is not expected to affect cultural resources. The case-specific studies required prior to issuance of a lease would be expected to prevent impacts on cultural resources. Under this alternative the list of stipulations, best management practices, and procedures outlined in the 2008 Geothermal PEIS would serve as guidance for future geothermal leasing and development and protection of cultural resources; however, the regionally specific stipulations outlined under Alternative 1, would not be implemented.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area. This alternative would result in greater limitations for the siting of geothermal plants and would reduce the potential for impacts on cultural resources.

4.16.5 Potential Impacts for the Austin Geothermal Decision Area**Alternative 1**

The Forest Service would consent to lease up to approximately 3,961 acres of National Forest System lands in the Austin Geothermal Decision Area and up to 2,202 acres would be disturbed. Impacts of the nature and type described above would likely result should development occur in the decision area. As there are many known cultural resources within the area, there would be a high likelihood that known or anticipated sites could be impacted as a result of geothermal development. The chance for discovery of unknown sites or impacts on known eligible sites would be lessened due to the small footprint for projects' surface

disturbance. Most of the cultural resources that could be encountered could be avoided or mitigated to reduce geothermal development impacts. The magnitude and extent of impacts on cultural resources would ultimately depend on the current condition of the resources and their eligibility for the NRHP. However, impacts would be reduced by implementation of NSO and CSU stipulations outlined in Appendix A. In addition, if cultural resources are determined to be within the area of effect of proposed development, then other standard cultural resources stipulations (e.g., construction monitoring, avoidance requirements around sites, etc.) would be applied. Application of the 200 foot buffer around TCPs would also protect these areas from direct impacts associated with future development. The applied 200 foot buffer may afford some protection against visual, aural, and atmospheric intrusions, but to what extent would need to be determined at the time a project is proposed and based on the proposal's location. Native American consultation during siting and design would provide the opportunity for further reducing the visual, aural, and atmospheric impacts.

Alternative 2

Impacts under this alternative would be similar in nature and type as those described under Common Impacts Associated with Geothermal Development and Alternative 1. However, under Alternative 2, the Forest Service would apply a one-mile buffer around TCPs, which would create a larger protection area around them and reduce the likelihood for impacts to low or moderate. Direct impacts would be reduced from a potential development and the stricter stipulation under this alternative would further reduce indirect visual, aural, and atmospheric impacts. A development would be farther away from a TCP and therefore be less visible and/or audible to an observer within the TCP. Also the NSO stipulations for sage-grouse would apply to approximately 1,600 acres within the decision area.

Alternative 3

Impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts on cultural resources would be similar to those described for the Bridgeport Geothermal Decision Area. However, the NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area.

4.16.6 Potential Impacts for the Ely Geothermal Decision Area

Alternative 1

The Forest Service would consent to lease up to approximately 3,538 acres of National Forest System lands in the Ely Geothermal Decision Area and up to 367 acres would be disturbed. Impacts of the nature and type described above would likely result should development occur in the decision area. As there are

over 50 known cultural resources within the area, there would be a high likelihood that known or anticipated sites could be impacted as a result of geothermal development. Further, since there are eligible sites in the decision area there is a moderate likelihood for impacting known eligible sites. The discovery of unknown sites or impacts on known eligible sites would be lessened due to the small footprint for projects' surface disturbance. Most of the cultural resources that could be encountered could be avoided or mitigated to reduce geothermal development impacts. However, the magnitude and extent of impacts on cultural resources would ultimately depend on the current condition of the resources and their eligibility for the NRHP. In addition, impacts would be reduced by implementation of NSO and CSU stipulations outlined in Appendix A. If cultural resources are determined to be within the area of effect of proposed development, then other standard cultural resources stipulations (e.g., construction monitoring, avoidance requirements around sites, etc.) would be applied. Application of the 200 foot buffer around TCPs would protect these areas from direct impacts associated with future development. The applied 200 foot buffer may afford some protection against visual, aural, and atmospheric intrusions upon a TCP, but to what extent would need to be determined at the time a project is proposed and based on the proposal's location. As there are few eligible sites (which may include TCPs) within this area, there would be a low likelihood for impacts on these sites. Native American consultation during siting and design would provide the opportunity for further reducing the visual, aural, and atmospheric impacts.

Alternative 2

Impacts would be similar to those described for the Bridgeport Geothermal Decision Area. In addition, the NSO stipulations for sage-grouse under this alternative would apply to approximately 3,300 acres within the decision area, reducing any impacts on cultural resources.

Alternative 3

Impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse would decrease the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area, reducing impacts on cultural resources.

4.16.7 Potential Impacts for the Tonopah Geothermal Decision Area

Alternative 1

The Forest Service would consent to lease up to approximately 166 acres of National Forest System lands in the Tonopah Geothermal Decision Area and up

to 166 acres would be disturbed. Impacts of the nature and type described above would likely result should development occur in the decision area. As there are so few known cultural resources within the area, there would be a low likelihood that known or anticipated sites could be impacted as a result of geothermal development. This chance for discovery would be lessened further due to the small footprint for projects' surface disturbance. As stated previously, most of the cultural resources could be avoided or mitigated to reduce geothermal development impacts and the magnitude and extent of impacts on cultural resources would depend on the current condition of the resources and their eligibility for the NRHP. However, impacts would be reduced by implementation of NSO and CSU stipulations outlined in Appendix A. In addition, if cultural resources are determined to be within the area of effect of proposed development, then other standard cultural resources stipulations (e.g., construction monitoring, avoidance requirements around sites, etc.) would be applied. Application of the 200 foot buffer around TCPs, should they be present in the area, would protect the TCPs from direct impacts associated with future development. The applied 200 foot buffer may afford some protection against visual, aural, and atmospheric intrusions upon a TCP, but to what extent would need to be determined at the time a project is proposed and based on the proposal's location. As there are so few eligible sites (which may include TCPs) within this area, there would be a very low likelihood for impacts on these sites. Native American consultation during siting and design would provide the opportunity for further reducing the visual, aural, and atmospheric impacts.

Alternative 2

Impacts would be similar to those described for the Bridgeport Geothermal Decision Area

Alternative 3

Impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

The updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO and restrict geothermal development within the entire decision area. Therefore, impacts on cultural resources would be minimal.

4.17 TRIBAL INTERESTS AND TRADITIONAL CULTURAL RESOURCES

This section discusses impacts on tribal interests and traditional cultural resources from the alternatives described in Chapter 2.

4.17.1 Scoping Comments on the Resource

The following scoping comments and issues were identified during the scoping process:

- Commenters stressed the importance of the Humboldt-Toiyabe National Forest as a culturally significant area, highlighting the following points: dependence on spring waters, native plants and medicines, and watersheds.
- Commenters wanted to protect sacred sites, burial sites, ceremonial sites, medicine sites, old village sites, hunting grounds, etc., from adverse impacts related to geothermal development.
- Commenters wanted the Forest Service to implement a meaningful and ongoing consultation program with Native American tribes throughout the project.

Issue: Potential adverse impacts on Native American resources, including impacts on the following:

- Traditional Cultural Properties;
- archaeological sites;
- hot springs;
- traditional practices and beliefs of regional Native Americans;
- tribal traditional use of forest resources; and/or
- lands, waters, and resources that are considered sacred by Native Americans in the region.

4.17.2 How Resource Impacts Were Evaluated

Methodology

Tribal consultations on the project including leasing consent determinations and lease stipulations are ongoing. Leasing consent does not grant any rights or authorize any activities affecting tribal interests or resources; therefore, the impact analysis focuses on the anticipated future actions consistent with the implementation of the alternatives described in Chapter 2.

BLM conducted government-to-government tribal consultations with affected federally recognized Indian tribes to identify tribal interest, treaty rights, and traditional and heritage resources within the National Forest System planning area. Also, all laws, regulations, and policies pertinent to determining effects on tribal interests and resources (such as Executive Order 13007, Native American Sacred Sites) were considered and included in impacts criteria. This known information was overlain with the actions found under each alternative (which included the proposed stipulations from Appendix A), and conclusions were drawn based on an understanding of how these types of actions may affect known and potentially discoverable resources. Throughout the analysis process, assumptions were verified.

Indicators

Potential impacts on tribal interests or traditional and heritage resources could occur if anticipated future actions consistent with implementing the alternatives were to:

- Conflict with land uses, management, and economic wellbeing of adjacent or nearby reservations, trust lands, restricted Indian allotments, and federally tribal-dependent Indian communities;
- Conflict with the exercise of off-reservation treaty and reserved rights, including grazing rights, hunting and fishing rights, gathering rights and interests, and water rights;
- Conflict with federal trust responsibilities to tribes and individual Indians regarding real property, physical assets, or intangible property rights;
- Conflict with existing court decisions, laws, policies, executive orders, and agency agreements with tribes regarding land and resource use;
- Result in proposed uses that are incompatible with maintaining and identifying cultural resources and their qualities;
- Have an adverse effect on historic properties or their settings, especially traditional cultural properties and cultural landscapes under Section 106 of the NHPA (36 CFR 800);
- Impact or restrict access to traditionally used hunting, fishing, and gathering areas and species;
- Change or reduce access to traditionally used or culturally important water sources and hot springs;
- Impact culturally important trails or trail systems; or
- Impact sacred sites or their settings, access, or use.

Assumptions

This analysis assumes the following:

- Areas proposed for leasing would likely include lands where there are tribal interests and traditional and heritage resources that are not currently identified;
- The Forest Service would continue to coordinate with Indian Tribal governments to identify issues and concerns during all phases of geothermal leasing and/or development;
- There may also be unidentified conflicts with existing tribal treaty rights or claims of ownership related to hot springs and water sources.

4.17.3 Common Impacts Associated with Geothermal Development

The nature and characteristics of the impacts on tribal interests and traditional and heritage resources associated with geothermal development as a result of the decisions common to all action alternatives would be the same as those described in the 2008 Geothermal PEIS (BLM and Forest Service 2008) is incorporated by reference and summarized here.

Types of impacts that could occur from exploration, drilling operations, utilization, and reclamation and abandonment include direct disturbance of locations or landscapes associated with traditional beliefs, resource gathering areas, hunting and fishing areas, water sources, hot springs, ancestral sites, human remains, and trails. Other impacts could result from alterations of visual and aural aspects of the cultural landscape's setting both on the lease site and in adjacent areas; increased access and site workers, which could lead to increased incidents of vandalism, unauthorized collection of ancestral sites; decreased tribal member access or interference with the exercise of treaty rights or cultural uses and practices such as resource gathering or hunting; and the potential for erosion, pollution, habitat loss, and less tangible changes to natural features and resources that tribal members may consider sacred.

Exploration, drilling operations, and utilization in or around hot spring sources would likely impact traditional and heritage resources and could possibly impact other tribal interests. Impacts could include loss of access, interference with use, and changes in flow or temperature of hot springs. Since the thermal water in these springs is often considered sacred, there is a potential for loss of sacred sites, and the healing energy and power they provide to the tribal users who value them.

While visual and aural settings could be restored and it may be possible to restore some habitats, it is unlikely that some cultural or sacred uses could be restored. Changes in flow or temperature of hot springs would not be restored, and cultural uses and religious value may be permanently lost.

4.17.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative 1

The Forest Service would consent to lease up to approximately 602,115 acres of National Forest System lands in the Bridgeport Geothermal Decision Area and up to 2,202 acres would be disturbed. Impacts of the nature and type described above would likely result should development occur. As there are many known important and significant traditional and heritage resources within the decision area, there would be a high likelihood that they could be directly and/or indirectly impacted as a result of geothermal development. The chance for discovery of previously unknown locations or direct and/or indirect impacts on known traditional and heritage resources would be lessened due to the small footprint for projects' surface disturbance. Many of the traditional and heritage

resources that may be encountered could be avoided or mitigated to reduce direct geothermal development impacts. Indirect impacts on traditional resources, such as visual, aural, and/or atmospheric intrusions are more difficult to mitigate or avoid, and are best addressed through intensive tribal consultation. The magnitude and extent of both direct and indirect impacts on traditional and heritage resources would depend on the outcome from tribal consultation and siting of geothermal facilities. If traditional and heritage resources are determined to be within the area of effect of proposed development, then application of the 200 foot buffer around TCPs and Native American sacred sites as determined through tribal consultation would protect these areas from direct impacts associated with future development. The applied 200 foot buffer may afford some protection against visual, aural and atmospheric intrusions upon the cultural or heritage resources, but to what extent would need to be determined at the time a project is proposed and based on the proposal's location. As there are many important and significant sites within this area, there would be a high to moderate likelihood for impacts on these sites. Native American consultation during siting and design would provide the opportunity for further reducing the visual, aural and/or atmospheric impacts.

Alternative 2

Impacts under this alternative would be similar in nature and type as those described above under Common Impacts Associated with Geothermal Development and Alternative 1. However, under Alternative 2, the Forest Service would apply a one-mile buffer around TCPs and Native American sacred sites (as determined through tribal consultation) which would create a larger protection area around these resources and reduce the likelihood for impacts to low. There would not only be no direct impact from a potential development, the stricter stipulation under this alternative would also reduce indirect visual, aural or atmospheric impacts. A development would be farther away from the cultural or heritage resources and therefore be less visible and/or audible to an observer within the TCP or sacred site. Also, the NSO stipulations for sage-grouse would apply to approximately 169,600 acres within the decision area further reducing impacts on tribal interests and traditional cultural resources.

Alternative 3

Under Alternative 3, lease applications would continue to be processed on a case-by-case basis. Areas closed to geothermal leasing by statute, regulation, or orders would remain closed, and discretionary closed areas would be assessed based on the LRMP. The number of acres likely to be affected under this alternative is unknown. Issuing geothermal leases on a case-by-case basis would result in direct and indirect effects as those noted above in Common Impacts Associated with Geothermal Development section. The case-specific consultation required prior to issuance of a lease is expected to avoid and/or mitigate direct and indirect impacts on traditional and heritage resources. Under

this alternative the list of stipulations and procedures outlined in the 2008 Geothermal PEIS would serve as guidance for future geothermal leasing and development and protection of traditional and heritage resources; however the regionally specific stipulations developed for Alternative 1 would not be implemented.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 2. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area. This alternative would result in greater limitations for the siting of geothermal plants and infrastructure, which could reduce impacts on tribal interests and traditional cultural resources.

4.17.5 Potential Impacts for the Austin Geothermal Decision Area

Alternative 1

The Forest Service would consent to lease up to approximately 3,961 acres of National Forest System lands in the Austin Geothermal Decision area and up to 367 acres would be disturbed. Impacts of the nature and type described above would likely result should development occur. As there are some known important and significant traditional and heritage resources within the decision area, there would be a moderate likelihood that they could be directly and/or indirectly impacted as a result of geothermal development. The chance for discovery of previously unknown locations or direct and/or indirect impacts on known traditional and heritage resources would be lessened due to the small footprint for projects' surface disturbance. Many of the traditional and heritage resources that may be encountered could be avoided or mitigated to reduce direct geothermal development impacts. Indirect impacts on traditional resources, such as visual, aural, and/or atmospheric intrusions are more difficult to mitigate or avoid, and are best addressed through intensive tribal consultation. The magnitude and extent of both direct and indirect impacts on traditional and heritage resources would depend on the outcome from tribal consultation and siting of geothermal facilities. If traditional and heritage resources are determined to be within the area of effect of proposed development, then application of the 200 foot buffer around TCPs and Native American sacred sites as determined through intensive tribal consultation would protect these areas from direct impacts associated with future development. The applied 200 foot buffer may afford some protection against visual, aural and atmospheric intrusions upon the cultural or heritage resources, but to what extent would need to be determined at the time a project is proposed and based on the proposal's location. As there are some important and significant sites within this area, there would be a moderate to low likelihood for impacts on these sites. Native American consultation during siting and design would

provide the opportunity for further reducing the visual, aural and/or atmospheric impacts.

Alternative 2

Impacts under this alternative would be similar in nature and type as those described above under Common Impacts Associated with Geothermal Development and Alternative 1. However, under Alternative 2, the Forest Service would apply a one-mile buffer around TCPs and Native American sacred sites (as determined through tribal consultation) which would create a larger protection area around these resources and reduce the likelihood for impacts to low. There would not only be no direct impact from a potential development, the stricter stipulation under this alternative would further reduce indirect visual, aural or atmospheric impacts. A development would be farther away from the cultural or heritage resources and therefore be less visible and/or audible to an observer within the TCP or sacred site. Also, the NSO stipulations for sage-grouse would apply to approximately 1,600 acres within the decision area.

Alternative 3

Impacts under Alternative 3 would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts on tribal interests and traditional cultural resources would be similar to those described for the Bridgeport Geothermal Decision Area. However, the NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area.

4.17.6 Potential Impacts for the Ely Geothermal Decision Area

Alternative 1

The Forest Service would consent to lease up to approximately 3,538 acres of National Forest System lands in the Ely Geothermal Decision Area, and impacts would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts under Alternative 2 would be similar to those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 3,300 acres within the decision area

Alternative 3

Impacts under Alternative 3 would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area. This would result in increased potential for development within the decision area but would not preclude other authorized uses of the area.

4.17.7 Potential Impacts for the Tonopah Geothermal Decision Area**Alternative 1**

The Forest Service would consent to lease up to approximately 166 acres of National Forest System lands in the Tonopah Geothermal Decision Area and up to 166 acres would be disturbed. Impacts of the nature and type described above would likely result should development occur in the proposed leasing area. However, as there are few known important and significant traditional and heritage resources within and adjacent to the area, there would only be a slight chance that they could be directly and/or indirectly impacted as a result of geothermal development. The chance for discovery of previously unknown locations or direct and/or indirect impacts on known traditional and heritage resources would be lessened due to the small footprint for projects' surface disturbance. Many of the traditional and heritage resources that may be encountered could be avoided or mitigated to reduce direct geothermal development impacts. Indirect impacts on traditional resources, such as visual, aural, and/or atmospheric intrusions are more difficult to mitigate or avoid, and are best addressed through intensive tribal consultation. The magnitude and extent of both direct and indirect impacts on traditional and heritage resources would depend on the outcome from tribal consultation and siting of geothermal facilities. If traditional and heritage resources are determined to be within the area of effect of proposed development, then application of the 200 foot buffer around TCPs and Native American sacred sites as determined through intensive tribal consultation would protect these areas from direct impacts associated with future development. The applied 200 foot buffer may afford some protection against visual, aural and atmospheric intrusions upon the cultural or heritage resources, but to what extent would need to be determined at the time a project is proposed and based on the proposal's location. As there are few known important and significant sites within this area, there would be a low likelihood for impacts on these sites. Native American consultation during siting and design would provide the opportunity for further reducing the visual, aural and/or atmospheric impacts.

Alternative 2

Impacts under this alternative would be similar in nature and type as those described above under Common Impacts Associated with Geothermal Development and Alternative 1. Under Alternative 2, the Forest Service would apply a one-mile buffer around TCPs and Native American sacred sites (as determined through tribal consultation) which would create a larger protection

area around these resources; as there are few important or significant sites within this area, this stipulation would reduce the likelihood for impacts to low or negligible. There would not only be no direct impact from a potential development, the stricter stipulation under this alternative would further reduce indirect visual, aural or atmospheric impacts. A development would be farther away from the cultural or heritage resources and therefore be less visible and/or audible to an observer within the TCP or sacred site.

Alternative 3

Impacts under Alternative 3 would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 2. However, the updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to the entire decision area, reducing impacts on tribal interests and traditional cultural resources.

4.18 NATIONAL SCENIC AND HISTORIC TRAILS

This section discusses impacts on national scenic and historic trails from the alternatives described in Chapter 2.

4.18.1 Scoping Comments on the Resource

Commenters requested that potential impacts from geothermal resource development activities be addressed including impacts on National Scenic and Historic Trails and cultural resources.

4.18.2 How Resource Impacts Were Evaluated

Methodology

The methods to determine potential effects on National Scenic and Historic Trails included a review of GIS data for the planning areas. The National Scenic and Historic Trails GIS data were overlain on the four decision areas to determine the presence of trails and whether future actions may affect National Scenic and Historic Trail resources.

Indicators

Potential impacts on National Scenic and Historic Trails could occur if reasonably foreseeable future actions were to:

- Conflict with management goals and objectives set forth by the agency or agencies responsible for trail-wide management and by the Forest Service with on-site jurisdiction in order to sustain these resources and their visual or historic qualities;

- Result in proposed uses that are incompatible with maintaining and identifying National Scenic and Historic Trails and their qualities within and adjacent to their boundaries;
- Utilize all or any portion of a National Scenic and Historic Trail during any phase of geothermal development; or
- Install facilities or transmission lines within a National Scenic and Historic Trail's historic or scenic landscape.

4.18.3 Common Impacts Associated with Geothermal Development

Due to the inability to predict the location, scope, scale, and timing of future development, the following impact analysis provides a general description of common impacts on from geothermal development. The analysis assumes that land occupied by National Scenic and Historic Trails would be closed to leasing, and that CSUs would be applied to National Forest System lands with a Visual Quality Objective of Retention and other sensitive viewsheds, such as within the visual setting of National Scenic and Historic Trails.

4.18.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative 1

Under Alternative 1, the Forest Service would consent to lease up to approximately 602,115 acres of National Forest System lands in the Bridgeport Geothermal Decision Area and up to 2,202 acres would be disturbed. Alternative 1 would not have any direct impact on National Scenic and Historic Trails; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in impacts.

Leasing would include stipulations from Chapter 2 of the 2008 Geothermal PEIS and other stipulations determined to be reasonable and necessary to protect National Scenic and Historic Trail resources, as outlined in Appendix A including a NSO within 200 feet of eligible National Register sites, historic properties, or unevaluated archeological historic sites and a CSU for areas with Visual Quality Objective of Retention and other sensitive viewsheds such as those within the visual setting of National Scenic and Historic Trails.

Based on the NSO and CSU stipulations for leasing, the portion of the California National Historic Trail located within the decision area would not be impacted by geothermal leasing or future activities. There are no scenic trails within the decision area; therefore, this resource would not be impacts by geothermal leasing or development.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be subject to NSO stipulations. The NSO stipulations for sage-grouse would apply to approximately

169,600 acres within the decision area. The stricter stipulations under this alternative would reduce indirect visual, aural, or atmospheric impacts on National Scenic and Historic Trails.

Alternative 3

Alternative 3 would not lead to consent or non-consent for lands within the decision area. Processing of geothermal lease applications and nominations would continue; however, they would be evaluated on a case-by-case basis under separate NEPA analyses. The CSU stipulation specified under Alternative 1 would not be implemented; therefore, Alternative 3 could potentially result in impacts on National Historic Trails.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area.

4.18.5 Potential Impacts for the Austin Geothermal Decision Area

Alternative 1

Under Alternative 1, the Forest Service would consent to lease up to approximately 3,961 acres of National Forest System lands.

The Pony Express National Historic Trail is located approximately 2 miles south of the Austin Geothermal Decision Area and with the implementation of the CSU stipulation for sensitive viewsheds, no impacts from geothermal leasing, exploration, or development are anticipated.

Alternative 2

The impacts associated with Alternative 2 similar to those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 1,600 acres within the decision area.

Alternative 3

The impacts associated with Alternative 3 are the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts on national scenic and historic trails would be similar to those described for the Bridgeport Geothermal Decision Area. However, the NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area.

4.18.6 Potential Impacts for the Ely Geothermal Decision Area

Alternative 1

There are no National Scenic or Historic Trails in the Ely Geothermal Decision Area; therefore, there would be no impacts on this resource from Alternative 1.

Alternative 2

There are no National Scenic or Historic Trails in the Ely Geothermal Decision Area; therefore, there would be no impacts on this resource from Alternative 2.

Alternative 3

There are no National Scenic or Historic Trails in the Ely Geothermal Decision Area; therefore, there would be no impacts on this resource from Alternative 3.

Alternative 4 (Preferred Alternative)

There are no National Scenic or Historic Trails in the Ely Geothermal Decision Area; therefore, there would be no impacts on this resource from Alternative 3.

4.18.7 Potential Impacts for the Tonopah Geothermal Decision Area

Alternative 1

There are no National Scenic or Historic Trails in the Tonopah Geothermal Decision Area; therefore, there would be no impacts on this resource from Alternative 1.

Alternative 2

There are no National Scenic or Historic Trails in the Ely Geothermal Decision Area; therefore, there would be no impacts on this resource from Alternative 2.

Alternative 3

There are no National Scenic or Historic Trails in the Tonopah Geothermal Decision Area; therefore, there would be no impacts on this resource from Alternative 3.

Alternative 4 (Preferred Alternative)

There are no National Scenic or Historic Trails in the Ely Geothermal Decision Area; therefore, there would be no impacts on this resource from Alternative 2.

4.19 VISUAL RESOURCES

This section discusses impacts on visual resources from the alternatives described in Chapter 2.

4.19.1 Scoping Comments on the Resource

No specific comments related to visual resources were received from the public. However, visual resource issues include development of geothermal energy on National Forest System lands in a manner compatible with scenic values and with Forest Service Visual Quality Objectives.

4.19.2 How Resource Impacts Were Evaluated

Methodology

The impact analysis for visual resources was based on review of existing baseline data for the planning area as described in Section 3.20 and information gathered through scoping. To the extent practical, spatial data were used to compare environmental conditions with the alternatives. Various actions that might create changes to the basic landscape elements (such as form, line, color, and texture) were considered in identifying potential impacts.

Indicators

Potential impacts on visual resources could occur if reasonably foreseeable future actions were to:

- Have adverse effects on a scenic vista;
- Degrade the existing visual character or quality of the site and its surroundings;
- Create a new source of light or glare; or
- Be incompatible with the Visual Quality Objectives.

Assumptions

Receptors sensitive to disturbances of visual resources are varied and depend on the landscape's visual resources; the project's location; the view distance, angle, and duration; the location of travel routes; public areas of interest; the season; the topography; recreation activities; and the number of viewers. Because of this, it is important to note that site-specific impact assessment is needed to thoroughly assess impacts on visual resources from a particular project. Without precise information about a specific project, it is not possible to detail the visual impacts. However, by using the RFDS as a general description of expected geothermal resource development activities, a generalized assessment of the possible impacts on visual resources can be made by describing the range of expected visual changes.

- Other visual impact mitigation measures would likely be required at the project-specific phase of analysis and permitting;
- Scenic resources will remain in demand on public lands;
- Any new surface-disturbing geothermal activities would be subject to further NEPA analysis, which would include an analysis to determine consistency with applicable visual resource objectives.

4.19.3 Common Impacts Associated with Geothermal Development

Due to the inability to predict the location, scope, scale, and timing of future development, the following impact analysis provides a general description of common impacts on visual resources from geothermal development. The

information presented in the Common Impacts to Visual Resources with Geothermal Development section of the 2008 Geothermal PEIS (BLM and Forest Service 2008) is incorporated by reference and summarized here.

Geothermal development would not result in any changes inconsistent with management objectives. Power plants and infrastructure would be sited in accordance with VQO. Specific visual impacts in regard to project location would be evaluated on a site-specific basis and would most likely have to comply with defined mitigation measures to reduce visual impacts as much as possible.

Receptors sensitive to disturbances of visual resources are varied and depend on the landscape's visual resources; the project's location; the view distance, angle, and duration; the location of travel routes; public areas of interest; the season; the topography; recreation activities; and the number of viewers. Because of this, it is important to note that site-specific impact assessment is needed to thoroughly assess impacts on visual resources from a particular project. Without precise information about a specific project, it is not possible to detail the visual impacts. However, by using the RFDS as a general description of expected geothermal resource development activities, a generalized assessment of the possible impacts on visual resources can be made by describing the range of expected visual changes.

As a result of typical exploration and drilling phase activities, the following alterations to visual resources would likely occur:

- Vegetation damage creating changes in texture and color;
- Scarring of the terrain from vehicles creating changes in texture, form, and color;
- Truck-mounted drilling rig and support equipment detracting from the natural environment creating changes in line, form, texture, and color;
- Building new roads and creating new linear features on the landscape;
- Fugitive dust from construction activities and newly exposed soils diminishing views and atmospheric clarity; and
- Lighting during drilling and for safety intruding on the night sky.

With the exception of some road and well locations, these disturbances would be short term, lasting for the duration of the individual activities with reclamation to Forest Service guidelines likely occurring immediately following completion of the activities. Utilization phase activities would likely result in many of the same impacts noted for previous development phases with the addition of:

- Clearing of vegetation for additional production wells creating changes in texture, color, and form;
- Building new structures and roads creating new form and linear features on the landscape;
- Release of steam plumes diminishing views and atmospheric clarity; and
- Conversion of undeveloped land to land with human-made structures.

These impacts would be greater during the utilization phase than in previous phases. They would last the duration of actual construction activities (short term), but many impacts, such as intrusion of wells and a power plant on the viewshed, would be long term, lasting the life of the project (10 to 30 years).

Reclamation and abandonment activities would be similar to those identified under other geothermal development phases; however, these impacts would occur to return the area to pre-construction conditions and would be beneficial from a Visual Quality Objectives perspective.

4.19.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative I

Alternative I would not have any direct impact on visual resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Impacts under this alternative would be of the same type and nature as those described in the Common Impacts section. Future actions based on the RFDS could result in changes that impact visual resources. All geothermal development would be sited with consideration to Visual Quality Objectives in the Bridgeport Geothermal Decision Area.

Future geothermal development activities could involve the introduction of equipment, structures, roads, and operations that are described in the RFDS, which would alter the characteristic landscape and be sources of light and glare. These impacts would be noticeable, because they would be in areas that are relatively undeveloped, would be readily visible due to topography and lack of obstructions, and would be near areas where recreation may take place. It is assumed the stipulations would result in positioning new structures, roads, and operations in the landscape so they would remain visually subordinate to the characteristic landscape, and would result in landform and vegetation alterations that blend in with the surrounding landscape character. Specifically, CSU stipulations would protect visual resources in areas identified as Retention, as well as other sensitive viewsheds (including the California Historic Trail). Other NSO and CSU stipulations would protect viewsheds through protection of

valued recreation areas, residential areas and other adjacent urban uses, cultural resources, and designated inventoried roadless areas.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be protected with an NSO stipulation. The NSO stipulations for sage-grouse would apply to approximately 169,600 acres within the decision area. The additional stipulations under Alternative 2 would further protect viewsheds as described for Alternative 1.

Alternative 3

Issuing geothermal leases on a case-by-case basis based on the LRMP is not expected to directly affect visual resources. Visual resources would continue to be managed consistently with current objectives. The type and nature of impacts from geothermal development under this alternative would be the same as those described above in the Common Impacts section. In the absence of consenting to lease lands within the Bridgeport Geothermal Development Area, no regionally specific lease stipulations for geothermal leasing, lease nominations and project development would result. Therefore, Alternative 3 would have less defined protection of visual resources than Alternative 1.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 2. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area.

4.19.5 Potential Impacts for the Austin Geothermal Decision Area

Alternative 1

Impacts on visual resources in the Austin Geothermal Decision Area would be similar to those described for the Bridgeport Geothermal Decision Area. It is anticipated that impacts under Alternative 1 would be minimized due to the implementation of lease stipulations. Development would be sited with consideration to Visual Quality Objectives.

Alternative 2

Impacts on visual resources would be similar to those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 1,600 acres within the decision area.

Alternative 3

Impacts on visual resources would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts on visual resources would be similar to those described for the Bridgeport Geothermal Decision Area. However, the NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area; therefore, impacts on visual resources would be minimal.

4.19.6 Potential Impacts for the Ely Geothermal Decision Area***Alternative 1***

Impacts on visual resources in the Ely Geothermal Decision Area would be similar to those described for the Bridgeport Geothermal Decision Area. It is anticipated that impacts under Alternative 1 would be minimized due to the implementation of lease stipulations. Specifically, stipulations would protect visual resources in designated inventoried roadless areas. Development would be sited with consideration to Visual Quality Objectives.

Alternative 2

Impacts on visual resources would be similar to those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 3,300 acres within the decision area.

Alternative 3

Impacts on visual resources would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for the Bridgeport Geothermal Decisions Area. However, the updated habitat data and protection measures for greater sage-grouse would decrease the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area.

4.19.7 Potential Impacts for the Tonopah Geothermal Decision Area***Alternative 1***

Impacts on visual resources in the Tonopah Geothermal Decision Area would be similar to those described for the Bridgeport Geothermal Decision Area. However, due to the small size of the decision area, there would be less flexibility in siting a geothermal plant and infrastructure. This could increase the likelihood of adverse impacts on visual resources on adjacent lands. It is anticipated that impacts under Alternative 1 would be the minimized due to the implementation of lease stipulations. Specifically, CSU stipulations would protect views associated with the Arc Dome Wilderness (located approximately one-half-mile to the west of the planning area) and designated inventoried roadless areas. Development would be sited with consideration to Visual Quality Objectives.

Alternative 2

Impacts on visual resources would be similar to those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse do not affect any lands within the decision area. The increase in NSO acres within the decision area would be directly related to the stipulations for Native American concerns.

Alternative 3

Impacts on visual resources would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 2. However, the updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO and restrict geothermal development within the entire decision area. Therefore, impacts on visual resources would be minimal.

4.20 SOCIAL INTERESTS, ECONOMICS, AND ENVIRONMENTAL JUSTICE

This section discusses impacts on social interests, economics, and environmental justice from the alternatives described in Chapter 2.

4.20.1 Scoping Comments on the Resource

The following comments and issues were identified during the scoping process:

- Commenters noted the importance of Nevada's role in geothermal development, while other commenters were concerned with the impacts on their personal economy from the adverse effects of geothermal development.
- Commenters expressed support for the project because of geothermal development's ability to provide jobs.

Issues: Socioeconomic issues include potential adverse impacts on the local and regional economy and quality of life (e.g., loss of recreational opportunities; emotional distress to local residents, business owners, and tourists; and loss of income to local residents/businesses).

4.20.2 How Resource Impacts Were Evaluated**Methodology**

Impacts were analyzed in terms of the predicted increase in geothermal energy activities and the associated changes expected in employment, income, tax revenue, royalties, public infrastructure needs, and other socioeconomic factors. The location of such development could occur anywhere in the planning area where consent to leasing has been granted. Components of geothermal plant

construction and operation, including the number of temporary and permanent workers required, are partially determined by plant production potential.

The analysis of socioeconomic and environmental justice issues associated with the development of geothermal facilities considers impacts within the counties where the four decision areas are located.

Indicators

The consent to geothermal leasing and the issuance of geothermal leases would not impact environmental justice. Impacts would result from the lease revenues as well as future construction and operation of geothermal energy projects in the planning area based on future leases. Potential impacts on socioeconomics and environmental justice could occur if reasonably foreseeable future actions were to:

- Impact other land uses that currently create revenue;
- Induce growth or population concentrations and cause additional demands on housing or social services that could not be met by the local communities;
- Cause a change in local or planning area employment;
- Have a disproportionately high and adverse impact on minority populations; or
- Have a disproportionately high and adverse impact on low-income populations. In the event impacts are significant, disproportionality would be determined by comparing the proximity of any high and adverse impacts with the location of low-income and minority populations.

4.20.3 Common Impacts Associated with Geothermal Development

The issuance of geothermal leases would impact socioeconomics through the lease revenues with 50 percent of revenues going to the state, 25 percent of revenues going to the county and the remainder going to the US Treasury. In addition, impacts on area socioeconomics and environmental justice would vary depending on the types, timing, and location of development. Due to the inability to predict these conditions, the following impact analysis provides a general description of common impacts from geothermal resource development. The largest impact on socioeconomics would result from employment and income directly and indirectly associated with geothermal electricity plant construction and operation. In addition, geothermal power plants may generate additional revenue streams for local government including property taxes and royalties. Information and impacts for these factors are discussed at length in the 2008 Geothermal PEIS (BLM and Forest Service 2008), and this information is incorporated by reference and summarized here.

Activities associated with exploration and drilling operations provide temporary jobs for the local community near geothermal resources, as well as expenditures for fuel, lodging, food, and other needs providing stimulus to the local economy. These operations may also result to changes in air quality and water quality and supply and create noise and hazardous materials thus affecting recreational use on communities and businesses adjacent to the operations. However, given the location of the decision areas and the undeveloped natures of the lands as well as the low number of temporary jobs estimated to be associated with this phase of development, these impacts are expected to be low.

The level of impact resulting from utilization phase activities (construction, operations, and maintenance) generally varies depending on resource potential for the area. Based on the 2008 Geothermal PEIS (BLM and Forest Service 2008) construction income is estimated to be roughly nine million dollars per 50-MW power plant and associated activities. In summary, construction of a 50-MW power plant and the associated transmission lines would require a total of 1,870 person-months, or 155 person-years, with a variable number of employees required at any given time during construction. A 50-MW power plant is estimated to require approximately 37 permanent full-time jobs. Operations and maintenance income is estimated to be 3.2 million annually for a 50-MW plan.

Generally, employment would provide positive impacts on the surrounding area in the form of employment opportunities as well as secondary impacts from money spent in the local economy. Additionally, geothermal resource development may provide an opportunity to broaden the economic base of the communities in and around the planning area and would provide taxes and possible royalties to the county.

In the short term, during actual construction activities or exploration phase, other land uses and income derived from these uses may be displaced by geothermal development. In the long term, during the project's life or approximately 10 to 30 years, many other land uses may be compatible with geothermal use due to the small footprint of geothermal plants; however, the aesthetic value would be altered until completion of the reclamation phase.

4.20.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative I

Alternative I would result in impacts similar those described in Section 4.20.3. The alternative would have no direct impacts on environmental justice; however, geothermal exploration, development, and abandonment activities likely to follow leasing would potentially result in impacts on socioeconomics. Under Alternative I, lease stipulations, such as NSO, CSU, and timing limitations, would be applied based on site-specific resources as detailed in

Appendix A. Specific to socioeconomic resources, CSU stipulations would be applied to minimize the potential for adverse impacts on residential areas, local businesses, schools, other adjacent land uses. In addition, stipulations under Alternative 1 would limit the impacts on area resources and other existing land uses, thereby decreasing the likelihood that economic and social benefits derived from these resources would be impacted. In summary, the potential for impacts on local adjacent communities, including minority populations, are likely to be reduced under this alternative.

Based on the RFDS developed for this project and the information provided in the Geothermal PEIS, direct economic impacts of geothermal electricity generation are described in **Table 4-3**, Direct Economic Impacts of Geothermal Electricity Generation in Bridgeport Geothermal Decision Area.

Table 4-3
Direct Economic Impacts of Geothermal Electricity Generation in
Bridgeport Geothermal Decision Area

Estimated geothermal MW	240
Total construction jobs (temporary jobs) ¹	744
Construction income (million \$) ²	43.2
Operations and maintenance jobs (permanent, full time jobs) ³	178
Operations and maintenance income (million \$) ⁴	15.4
Property tax estimate (annual, in million \$) ⁵	7.2
Federal royalty estimate (30-year total, in million \$) ⁶	76.8

¹ Assuming an average of 3.1 total construction jobs/MW, per Hance 2005.

² Assuming a rate of \$9 million for 50-MW power plant, as discussed in BLM 2007c.

³ Assuming a rate of 0.74 permanent full time jobs/MW, per Hance 2005.

⁴ Assuming a rate of \$3.2 million annually for a 50-MW power plant, as discussed in BLM 2007c.

⁵ At rate generated in Imperial County (BLM 2007c).

⁶ With average electricity price of 6 cents/kilowatt hour and 95% capacity factor, following Kagel 2006.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be subject to NSO stipulations. The NSO stipulations for sage-grouse would apply to approximately 169,600 acres within the decision area.

Alternative 3

The specific economic impacts of this alternative cannot be determined. Employment, tax income, and other economic factors would likely continue based on current and future trends in the industry. Impacts would occur during subsequent exploration, drilling operations, and utilization phases. Impacts would vary depending on specific locations developed for geothermal resources. Under Alternative 3, geothermal leasing would be based on the existing LRMP. Consent to lease lands would not be granted for the decision area lands but

would be dealt with on a case-by-case basis, and no regionally specific lease stipulations would be applied. Alternative 3 would provide the less defined protection for socioeconomics and environmental justice than Alternative 1.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area. This alternative would result in greater limitations for the siting of geothermal plants and infrastructure, which could limit development and result in a greater impact to social and economic interests.

4.20.5 Potential Impacts for the Austin Geothermal Decision Area

Alternative 1

Alternative 1 would have no direct impact on socioeconomics or environmental justice; however, geothermal exploration, development, and abandonment activities likely to follow leasing would potentially result in such impacts. Under Alternative 1, lease stipulations, such as NSO, CSU, and TLs, would be applied based on site-specific resources as detailed in Appendix A. CSU stipulations would be applied to minimize the potential for adverse impacts on residential areas, local businesses, schools, other adjacent land uses. In addition, stipulations under Alternative 1 would limit the impacts on area resources and other existing land uses thereby decreasing the likelihood that economic and social benefits derived from these resources would be impacted. Also, given the limited size and remote location of the proposed geothermal projects there is limited potential for impacts on local adjacent communities, including minority populations.

Based on the RFDS developed for this project and the information provided in the 2008 Geothermal PEIS, direct economic impacts of geothermal electricity generation are described in **Table 4-4, Direct Economic Impacts of Geothermal Electricity Generation in Austin Geothermal Decision Area.**

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be subject to NSO stipulations. The NSO stipulations for sage-grouse would apply to approximately 1,600 acres within the decision area.

Alternative 3

Impacts on socioeconomics and environmental justice would be the same as those described for the Bridgeport decision area.

Table 4-4
Direct Economic Impacts of Geothermal Electricity Generation in Austin
Geothermal Decision Area

Estimated geothermal MW	50
Total construction jobs (temporary jobs) ¹	155
Construction income (million \$) ²	9.0
Operations and maintenance jobs (permanent, full time jobs) ³	37
Operations and maintenance income (million \$) ⁴	3.2
Property tax estimate (annual, in million \$) ⁵	1.5
Federal royalty estimate (30-year total, in million \$) ⁶	16

¹ Assuming an average of 3.1 total construction jobs/MW, per Hance 2005.

² Assuming a rate of \$9 million for 50-MW power plant, as discussed in BLM 2007c.

³ Assuming a rate of 0.74 permanent full time jobs/MW, per Hance 2005.

⁴ Assuming a rate of \$3.2 million annually for a 50-MW power plant, as discussed in BLM 2007c.

⁵ At rate generated in Imperial County (BLM 2007c).

⁶ With average electricity price of 6 cents/kilowatt hour and 95% capacity factor, following Kagel 2006.

Alternative 4 (Preferred Alternative)

Impacts on social interests, economics, and environmental justice would be similar to those described for the Bridgeport Geothermal Decision Area. However, the NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area. Therefore, this alternative would result in greater limitations for the siting of geothermal plants and infrastructure, which could limit development and result in a greater impact to social and economic interests.

4.20.6 Potential Impacts for the Ely Geothermal Decision Area

Alternative 1

Impacts on socioeconomics and environmental justice would be the same as those described for the Austin Geothermal Decision Area.

Alternative 2

Impacts on socioeconomics and environmental justice would be similar to those described for the Austin Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 3,300 acres within the decision area.

Alternative 3

Impacts on socioeconomics and environmental justice would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse would decrease the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area.

4.20.7 Potential Impacts for the Tonopah Geothermal Decision Area

Alternative 1

Impacts on socioeconomics and environmental justice would be the same as those described for the Austin Geothermal Decision Area.

Alternative 2

Impacts on socioeconomics and environmental justice would be similar to those described for the Austin Geothermal Decision Area.

Alternative 3

Impacts on socioeconomics and environmental justice would be the same as those described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO and restrict geothermal development within the entire decision area. Therefore, impacts on socioeconomics would be reduced.

4.21 HEALTH AND SAFETY

This section discusses impacts on health and safety from the alternatives described in Chapter 2.

4.21.1 Scoping Comments on the Resource

No comments on public health and safety were received during scoping.

4.21.2 How Resource Impacts Were Evaluated

Methodology

The methodology for the public health and safety impact analysis is incorporated by reference from the health and safety section of the 2008 Geothermal PEIS (BLM and Forest Service 2008).

Indicators

Impact criteria for public health and safety are incorporated by reference from the health and safety section of the 2008 Geothermal PEIS (BLM and Forest Service 2008). More specifically, the analysis discusses the potential for the exposure of construction workers, personnel, or the public, to hazards related to the exploration, development, or operational phases of a geothermal project. This section does not discuss hazards related to hazardous materials since they have been discussed separately under the Hazardous Materials section.

Assumptions

This analysis assumes the following:

- The risk of exposure to hazardous situations would be highest among geothermal project staff; the general public would have a lower risk of exposure due to the reduced likelihood of being on the project site during exploration, development, operations, and abandonment.
- All construction workers and operational personnel would work according to Occupational Health and Safety Administration standards to prevent or minimize health and safety risks.

4.21.3 Common Impacts Associated with Geothermal Development

The nature and characteristics of the impacts on public health and safety associated with geothermal development as a result of the decisions common to all action alternatives would be the same as those described in the 2008 Geothermal PEIS (BLM and Forest Service 2008) is incorporated by reference and summarized here.

Due to the inability to predict the location, scope, scale, and timing of future development, what follows is a general description of common impacts on public health and safety from geothermal resource development. Impacts could include:

- Exposure of individuals to geothermal steam during exploration and development drilling activities;
- Exposure of individuals to electrical fires or wildfires caused by project activities;
- Exposure of individuals to electric shock involved in maintenance of transmission lines and substations;
- Vehicular accidents due to increased traffic on local roads;
- A variety of potential accidents inherent to exploration, development, operations, maintenance, and reclamation and abandonment, as listed in the Geothermal PEIS; and
- A variety of potential accidents inherent to industrial facilities.

Potential public health and safety impacts would last for the duration of exploration activities (estimated between one and five years for an individual project), development phase (two to ten years for an individual project), and operations and maintenance phase (10 to 30 years for an individual project).

4.21.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative 1

There are no specific requirements or procedures related to public health and safety. There would be no increase in human exposure to hazards from geothermal leasing allocation decisions; however, impacts resulting from

anticipated future actions consistent with implementing Alternative 1 would be of the same nature and character as those described under Common Impacts associated with Geothermal Development.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be subject to NSO stipulations. The NSO stipulations for sage-grouse would apply to approximately 169,600 acres within the decision area.

Alternative 3

Impacts under Alternative 3 would be the same as described for Alternative 1, above.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area.

4.21.5 Potential Impacts for the Austin Geothermal Decision Area

Alternative 1

Impacts related to public health and safety from reasonably foreseeable future actions would be the same as described above for the Bridgeport Decision Area.

Alternative 2

Impacts related to public health and safety from reasonably foreseeable future actions would be similar to those described above for the Bridgeport Decision Area. The NSO stipulations for sage-grouse would apply to approximately 1,600 acres within the decision area.

Alternative 3

Impacts under Alternative 3 would be the same as described for Alternative 1, above.

Alternative 4 (Preferred Alternative)

Impacts on health and safety would be similar to those described for the Bridgeport Geothermal Decision Area. However, the NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area.

4.21.6 Potential Impacts for the Ely Geothermal Decision Area

Alternative 1

Impacts related to public health and safety from reasonably foreseeable future actions would be the same as described above for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts related to public health and safety from reasonably foreseeable future actions would be similar to those described above for the Bridgeport Decision Area. The NSO stipulations for sage-grouse would apply to approximately 3,300 acres within the decision area.

Alternative 3

Impacts under Alternative 3 would be the same as described for Alternative 1, above.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse would decrease the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area.

4.21.7 Potential Impacts for the Tonopah Geothermal Decision Area

Alternative 1

Impacts related to public health and safety from reasonably foreseeable future actions would be the same as described above for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts related to public health and safety from reasonably foreseeable future actions would be similar to those described above for the Bridgeport Decision Area

Alternative 3

Impacts under Alternative 3 would be the same as described for Alternative 1, above.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO and restrict geothermal development within the entire decision area. Therefore, impacts public health and safety would be reduced.

4.22 NOISE

This section discusses impacts on noise from the alternatives described in Chapter 2.

4.22.1 Scoping Comments on the Resource

No comments on noise were received during scoping.

4.22.2 How Resource Impacts Were Evaluated

Methodology

The methodology for the noise impact analysis is incorporated by reference from the noise section of the 2008 Geothermal PEIS (BLM and Forest Service 2008).

Indicators

Impact criteria for noise are incorporated by reference from the noise section of the 2008 Geothermal PEIS (BLM and Forest Service 2008). More specifically, the analysis discusses potential noise levels and compares these levels to those set by the Federal Geothermal Resources Operational Order Number 4, which mandates that noise levels must be 65 dBA or less at the geothermal lease boundary or 0.5 mile from the source, whichever is greater.

Assumptions

This analysis assumes the following:

- Future analysis for site-specific projects would identify the presence of sensitive noise receptors (e.g., residences or school) in the vicinity of the proposed well drilling or geothermal plant activities.
- Noise levels for the specific activities would be assessed to determine their compliance with applicable noise guidelines, and measures to reduce noise impacts would be identified if necessary.

4.22.3 Common Impacts Associated with Geothermal Development

The information presented in the Common Impacts on Noise Associated with Geothermal Development section of the 2008 Geothermal PEIS (BLM and Forest Service 2008) is incorporated by reference and summarized in this section. Noise levels associated with exploration, well pad development, power plant construction, and reclamation and abandonment would be temporary and short-term, while noise associated with geothermal plant operation would be long-term. Potential noise impacts related to the different phases of geothermal development are discussed below.

During construction heavy earth-moving equipment would be used to prepare access roads, drill pads, and the geothermal power plants. Sound pressure levels for these activities have been measured up to 95 dBA at a distance of 50 feet (Leitner undated). Because noise decreases with distance from the source, a 95-

dBA noise level would fall below 65 dBA at 1,500 feet from the noise source, therefore falling within the federal standard.

The dominant noise sources associated with well drilling are the large diesel engines that power the rotary rig and mud pumps and the large diesel-driven air compressors. These noise sources are consistent throughout drilling. Additional intermittent noise sources result from the hoisting of drill pipe or casing and the auto-driller. The noise of hoisting during drilling is usually masked by the air compressors, but the noise from auto-drillers is not. Well drilling generally occurs 24 hours per day for a number of days or months, depending upon the depth to the resource. Typical sound levels during drilling when mud is used as the circulating medium range from 75 to 85 dBA at 50 feet (Leitner undated). A noise level of 85 dBA decreases to 65 dBA at a distance of 500 feet from the noise source, therefore falling within the federal standard.

The process of flowing geothermal wells to test production capability generates noise. Noise is made primarily by the diesel generator that powers the down-hole electric pump, with lower noise level emitted from the fluids flowing through the well head and pipeline to the reinjection well. Increased noise levels may be realized from any additional diesel generator that is required to power a second pump at the injection well. Flow testing occurs 24 hours per day and is generally conducted for 30 to 90 days per well. Data from geothermal exploration in Imperial Valley, California, suggest that sound pressure levels during flow testing can be as high as 90 dBA at 50 feet (Leitner undated), reaching the 65-dBA level at 800 feet from the noise source, therefore falling within the federal mandate.

The primary source of noise at binary plants is the cooling towers, which have been recorded as generating noise in the range of 75 to 85 dBA at a distance of 50 feet. As described for well drilling, noise levels of 85 dBA decrease to 65 dBA at a distance of 500 feet from the noise source, therefore falling within the federal mandate.

As discussed above, phases of geothermal development produce temporary sources of noise in the exploration and development phases and long-term sources of noise during plant operation. The level of impact from these activities is highly dependent upon the surrounding land uses and the presence or absence of sensitive noise receptors.

4.22.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative 1

BLM Geothermal Resource Order Number 4, General Environmental Protection Requirements, mandates that noise from geothermal activities be 65 dBA or less at the lease boundary. Since leases are not issued on lands that also contain sensitive receptors such as residences, schools, or hospitals, the maximum noise potentially experienced by such a receptor would be 65 dBA.

This level of noise exposure would only occur if the receptor is located directly adjacent to the lease boundary. Due to the highly rural and unpopulated nature of lands within the Bridgeport Geothermal Decision Area, it is unlikely that any sensitive receptors would be directly adjacent to any lease boundary. Noise impacts from reasonably foreseeable future actions are expected to be minimal.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be subject to NSO stipulations and affect the siting of potential future geothermal plants. The NSO stipulations for sage-grouse would apply to approximately 169,600 acres within the decision area.

Alternative 3

Impacts under Alternative 3 would be the same as described for Alternative 1, above.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area.

4.22.5 Potential Impacts for the Austin Geothermal Decision Area

Alternative 1

No noise impacts are expected under this alternative since no sensitive receptors have been identified within one mile of the Austin Geothermal Decision Area.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. The NSO stipulations for sage-grouse would apply to approximately 1,600 acres within the decision area.

Alternative 3

Impacts under Alternative 3 would be the same as described for Alternative 1, above.

Alternative 4 (Preferred Alternative)

Impacts on noise would be similar to those described for the Bridgeport Geothermal Decision Area. However, the NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area.

4.22.6 Potential Impacts for the Ely Geothermal Decision Area

Alternative 1

No noise impacts are expected from reasonably foreseeable future impacts since no sensitive receptors have been identified within one mile of the Ely Geothermal Decision Area.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. The NSO stipulations for sage-grouse would apply to approximately 3,300 acres within the decision area.

Alternative 3

Impacts under Alternative 3 would be the same as described for Alternative 1, above.

Alternative 4 (Preferred Alternative)

The updated habitat data and protection measures for greater sage-grouse would decrease the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area.

4.22.7 Potential Impacts for the Tonopah Geothermal Decision Area

Alternative 1

No noise impacts are expected from reasonably foreseeable future impacts since no sensitive receptors have been identified adjacent to the Tonopah Geothermal Decision Area. From review of aerial maps, the nearest potential sensitive receptor is a possible residence located 0.7 mile to the south east of the lease parcel, across from the Highway 376 (Fremont Route). Darrouchs Hot Springs are located approximately 0.8 mile to the northeast of the parcel, also across this roadway.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for Native American concerns would increase the acreage subject to NSO stipulations, which would affect siting of a potential future geothermal plant.

Alternative 3

Impacts under Alternative 3 would be the same as described for Alternative 1, above.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO and restrict geothermal

development within the entire decision area. Therefore no noise impacts would be anticipated.

4.23 HAZARDOUS MATERIALS

This section discusses impacts on hazardous materials from the alternatives described in Chapter 2.

4.23.1 Scoping Comments on the Resource

No comments on hazardous materials were received during scoping.

4.23.2 How Resource Impacts Were Evaluated

Methodology

The methodology for the hazardous materials impact analysis is incorporated by reference from the health and safety section of the 2008 Geothermal PEIS (BLM and Forest Service 2008).

Indicators

Impact criteria for hazardous materials are incorporated by reference from the health and safety section of the 2008 Geothermal PEIS (BLM and Forest Service 2008). More specifically, the analysis discusses the potential for the exposure of construction workers, personnel, or the public, to hazardous materials either pre-existing in onsite soils at the site of a geothermal exploration or development project, or to hazardous materials used in the exploration, development, or operational phases of a geothermal project.

Assumptions

This analysis assumes the following:

- The risk of exposure to hazardous materials would be highest among geothermal project staff; the general public would have a lower risk of exposure due to the reduced likelihood of being on the project site during exploration, development, operations and abandonment.
- As part of a developer's due diligence and as part of NEPA analysis for future site-specific projects, lands would be examined for the potential for onsite contamination and remedial or protective actions would be taken per Occupational Health and Safety Administration standards to prevent or minimize worker exposure to such contamination.
- All construction workers would comply with Occupational Health and Safety Administration health and safety regulations and would follow use, storage, and transportation guidelines provided as part of Material Safety Data Sheets for any and all hazardous materials used in the drilling, development, and utilization phases of a geothermal project.

4.23.3 Common Impacts Associated with Geothermal Development

The nature and characteristics of the impacts related to hazardous materials associated with geothermal development as a result of the decisions common to all action alternatives would be the same as those described in the Health and Safety section of the 2008 Geothermal PEIS (BLM and Forest Service 2008) is incorporated by reference and summarized here.

Due to the inability to predict the location, scope, scale, and timing of future development, what follows is a general description of common impacts related to hazardous materials from geothermal resource development. Impacts could include:

- Exposure of people and the environment to drilling mud and geothermal fluid during exploration and development drilling activities;
- Exposure of people and the environment to hydrogen sulfide contained in geothermal fluid or steam during exploration, development, and operation phases;
- Exposure of people and the environment to hazardous materials used and stored at facilities, such as petroleum, oil, lubricants, paints, solvents, and herbicides; and
- Exposure of people and the environment to hazardous materials typical to construction activities such as paints, solvents, and herbicides.

Potential impacts related to hazardous materials would last for the duration of exploration activities (estimated between one and five years for an individual project), development activities (two to ten years for an individual project), and operations and maintenance activities (10 to 30 years for an individual project).

4.23.4 Potential Impacts for the Bridgeport Geothermal Decision Area

Alternative 1

There are no specific requirements or procedures related to hazardous materials. There would be no increase in human or environmental exposure to hazardous materials from geothermal leasing allocation decisions; however, impacts resulting from anticipated future actions consistent with implementing Alternative 1 would be of the same nature and character as those described under Common Impacts associated with Geothermal Development.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be subject to NSO

stipulations. The NSO stipulations for sage-grouse would apply to approximately 169,600 acres within the decision area.

Alternative 3

Impacts under Alternative 3 would be the same as described for Alternative 1, above.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area.

4.23.5 Potential Impacts for the Austin Geothermal Decision Area

Alternative 1

Impacts related to hazardous materials from Alternative 1 would be the same as described for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts related to hazardous materials from Alternative 2 would be similar to those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 1,600 acres within the decision area.

Alternative 3

Impacts under Alternative 3 would be the same as described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts on hazardous materials would be similar to those described for the Bridgeport Geothermal Decision Area. However, the NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area.

4.23.6 Potential Impacts for the Ely Geothermal Decision Area

Alternative 1

Impacts under Alternative 1 would be the same as described for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts under Alternative 2 would be similar to those described for the Bridgeport Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 3,300 acres within the decision area.

Alternative 3

Impacts under Alternative 3 would be the same as described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

The updated habitat data and protection measures for greater sage-grouse would decrease the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area.

4.23.7 Potential Impacts for the Tonopah Geothermal Decision Area**Alternative 1**

Impacts under Alternative 3 would be the same as described for the Bridgeport Geothermal Decision Area.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for Native American concerns would increase the acreage subject to NSO stipulations.

Alternative 3

Impacts under Alternative 3 would be the same as described for the Bridgeport Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO and restrict geothermal development within the entire decision area. Therefore, impacts related to hazardous materials would be minimal.

4.24 CLIMATE CHANGE

This section discusses climate change impacts from the alternatives described in Chapter 2.

4.24.1 Scoping Comments on the Resource

Issues identified through scoping include the potential for exploratory drilling and associated activities to contribute to global warming.

4.24.2 How Resource Impacts Were Evaluated**Methodology**

Greenhouse gases are chemical compounds in the Earth's atmosphere that allow incoming short-wave solar radiation but absorb long-wave infrared radiation re-emitted from the Earth's surface, trapping heat. Most studies indicate that the Earth's climate has warmed over the past century due to increased emissions of greenhouse gases, and that human activities affecting

emissions to the atmosphere are likely an important contributing factor. In the US, most greenhouse gas emissions are attributed to energy use. Such emissions result from combustion of fossil fuels used for electricity generation, transportation, industry, heating, and other needs. Energy-related carbon dioxide emissions represent 82 percent of total manmade greenhouse gas emissions in the US (EIA 2009). The methodology for climate change compares greenhouse gas emissions associated with geothermal power production against greenhouse gas emissions from other sources of energy generation, as described in the 2008 Geothermal PEIS Air Quality section.

Indicators

On September 22, 2009, the US Environmental Protection Agency (EPA) released final regulations for a Greenhouse Gas Monitoring Rule (see 74 Federal Register 56260). The reporting rule requires suppliers of fossil fuels or industrial greenhouse gases, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more per year of greenhouse gas emissions to submit annual reports to the EPA. As there are no Clean Air Act significance thresholds for evaluating greenhouse gases, this analysis compares likely greenhouse gas emissions from each alternative against the Greenhouse Gas Monitoring Rule.

4.24.3 Common Impacts Associated with Geothermal Development

The information on climate change presented in the Common Impacts on Air Quality and Atmospheric Values Associated with Geothermal Development section of the PEIS is incorporated here by reference. Leasing would have no direct impacts related to climate change.

Greenhouse Gas Emissions

Gases exhibiting greenhouse properties come from both natural and human sources. Carbon dioxide, methane, and nitrous oxide are examples of greenhouse gases. Temporary emissions of greenhouse gases associated with geothermal development would occur during all phases of geothermal development. Sources of these temporary greenhouse gas emissions are vehicles, truck traffic, and construction equipment required for exploration, well drilling, and power plant construction. As discussed under Section 4.10, Air Quality, well drilling also has the potential to release non-condensable gases such as carbon dioxide, hydrogen sulfide, methane, and ammonia. The amount and ratio of these constituents varies by geothermal resource, with carbon dioxide generally comprising over 95 percent of the non-condensable gases.

Table 4-2 of the PEIS showed carbon dioxide emission rates for different electricity generation sources, including geothermal, coal, petroleum, and natural gas. The average reported emission rates included the following:

- Geothermal: 0.2 pounds CO₂ per kilowatt hour
- Coal: 2.095 pounds CO₂ per kilowatt hour
- Petroleum: 1.969 pounds CO₂ per kilowatt hour

- Natural Gas: 1.321 pounds CO₂ per kilowatt hour

As shown by the emission rates above, electricity produced from geothermal sources emits a fraction of the carbon dioxide emitted by conventional energy sources. Therefore, electricity produced by a geothermal power plant would result in a net decrease in greenhouse gas emissions if power produced by the geothermal plant displaced electricity generated by conventional fossil fuel sources of electricity.

Climate Variability

Section 3.24, Climate Change, discusses the potential effects of climate change on areas of the western US, including Nevada. Predictions indicate that Nevada will experience an increase in temperature of 3 to 4°Fahrenheit in spring and fall and 5 to 6 degrees Fahrenheit in summer and winter (EPA 1998). Winters are expected to be wetter, and summers are expected to be more arid. Higher temperatures and increased winter rainfall could result in a reduction in snow pack, earlier snowmelts, and increased runoff (CEIR 2008). Such climate variability would affect both resources and resource uses within the Planning Area and could limit the effectiveness of BMPs, lease stipulations, and mitigation measures proposed to reduce geothermal project-related impacts. For example, increased drought conditions could result in a change in vegetation type of an area or could reduce the availability of water needed for dust control. Site-specific NEPA analyses would discuss the potential impact of climate change on that project, assess how the projected impacts of each the project could be exacerbated by climate change, and incorporate any additional mitigation measures, as appropriate.

4.24.4 Potential Impacts for the Bridgeport Decision Area

Alternative I

Alternative I would have no direct climate change impacts.

Indirect impacts would include the production of greenhouse gas emissions during all phases of geothermal development, including construction and well drilling. Greenhouse gases would be produced through the combustion of fuels used by construction equipment and construction-related vehicles. Greenhouse gases would also be emitted during well drilling as the gases are released from the geothermal resource itself. Any BMPs or measures designed to reduce equipment and vehicle exhaust emissions would also reduce greenhouse gas emissions.

Greenhouse gas emissions associated with the operation of geothermal power plants would include commute traffic, maintenance traffic, and truck deliveries and potential releases of carbon dioxide during maintenance. Actual release of greenhouse gas emissions would depend upon plant technology and design. Greenhouse gas emissions from each 50-MW power plant would be expected

to be well below the 25,000 tons per year reporting limit under the Greenhouse Gas Monitoring Rule.

As described above, geothermal power plant development could have an indirect beneficial impact if power produced by the geothermal plant displaced electricity generated by conventional fossil fuel sources of electricity.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be subject to NSO stipulations. The NSO stipulations for sage-grouse would apply to approximately 169,600 acres within the decision area.

Alternative 3

Under Alternative 3, lease applications would continue to be processed on a case-by-case basis. There is the potential that geothermal development could be delayed when compared with Alternative 1. Indirect impacts would be similar to those described for Alternative 1 but would likely occur at a slower pace.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for Alternative 1. However, the updated habitat data and protection measures for greater sage-grouse (including the bi-state population) would increase the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 183,900 acres within the decision area. This alternative would result in greater limitations for the siting of geothermal plants and infrastructure.

4.24.5 Potential Impacts for the Austin Decision Area

Alternative 1

Alternative 1 would have no direct impacts on climate change.

Indirect impacts would be similar in type to those described for the Bridgeport Geothermal Decision Area but would be much less in scale because the Austin Geothermal Decision Area has 50 MW of geothermal potential compared with 228 MW of potential for the Bridgeport decision area.

Alternative 2

Impacts under Alternative 2 would be similar to those described for Alternative 1. However, additional protection measures for greater sage-grouse and Native American concerns would increase the acreage that would be subject to NSO stipulations. The NSO stipulations for sage-grouse would apply to approximately 1,600 acres within the decision area.

Alternative 3

Impacts on climate change would be the same as those described for the Bridgeport Geothermal Decision Area at a lesser scale.

Alternative 4 (Preferred Alternative)

Impacts on climate change would be similar to those described for the Bridgeport Geothermal Decision Area. However, the NSO stipulations for sage-grouse would apply to approximately 3,110 acres within the decision area.

4.24.6 Potential Impacts for the Ely Decision Area**Alternative 1**

Impacts on climate change would be the same as those described for the Austin Geothermal Decision Area.

Alternative 2

Impacts on climate change would be similar to those described for the Austin Geothermal Decision Area. The NSO stipulations for sage-grouse would apply to approximately 3,300 acres within the decision area.

Alternative 3

Impacts on climate change would be the same as those described for the Austin Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

The updated habitat data and protection measures for greater sage-grouse would decrease the acreage subject to NSO. The NSO stipulations for sage-grouse would apply to approximately 800 acres within the decision area.

4.24.7 Potential Impacts for the Tonopah Decision Area**Alternative 1**

Impacts on climate change would be the same as those described for the Austin Geothermal Decision Area.

Alternative 2

Impacts on climate change would be similar to those described for the Austin Geothermal Decision Area.

Alternative 3

Impacts on climate change would be the same as those described for the Austin Geothermal Decision Area.

Alternative 4 (Preferred Alternative)

Impacts under Alternative 4 would be similar to those described for the Austin Geothermal Area. However, the updated habitat data and protection measures for sage-grouse would increase the acreage subject to NSO and restrict

geothermal development within the entire decision area thus reducing the likelihood for geothermal development and eliminating the indirect beneficial impact from a geothermal power plant.

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